ELECTRONICS Australia

HIFI NEWS

JULY, 1974
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BUILDING YOUR OWN ELECTRONIC ORGAN: BASIC CIRCUIT DETAILS

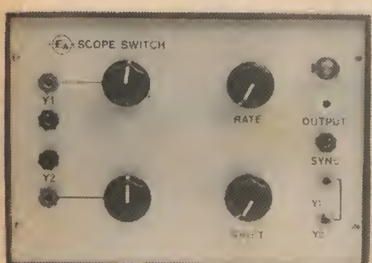
IS SOLAR POWER MAKING PROGRESS? * DANGERS IN POLICE COMPUTER NETWORKS * NEW SCOPE SWITCH

ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 36 No 4

A few weeks ago we set up this new Kenwood KR-9340 four channel FM-AM receiver, complete with CD-4 demodulator, and tried it out with two of the new Audio-Technica CD-4 magnetic cartridges. Our reaction to the resulting no-holds-barred four channel system is given in the story starting on page 6.



Want to look at two signals simultaneously with your single-trace scope? This new easy to build scope switch will let you do just that. The description starts on page 52.

Ever wondered just how automatic telephone exchanges work? The best way to find out is by building a simple exchange yourself, and this month we tell you how! See page 76.

On the cover

Sydney suburban housewife Mrs Joy Tarrant wires up a Schober "Dynabeat" rhythm attachment for the family's Schober theatre organ, watched by Pandora the Siamese cat. We are told that it worked as soon as it was switched on! Circuit details for the Schober recital organ are given in the article which starts on page 42.

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world of electronics and hi-fi

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Editorial Viewpoint

Australia, and a colour problem . . .

During the boom period which followed the introduction of television in 1956, dozens of companies got into the act, producing receivers and components for the hungry market. But, when demand subsided a few years later, the companies followed one another into liquidation, leaving behind a huge array of "orphan" receivers.

Fortunately, the result was not too traumatic. The orphan receivers employed typical Australian technology and they were kept going, for the most part, by an adequate number of component manufacturers and servicemen. The industry — and its customers — got out of the situation . . . just!

If you had asked me twelve months ago whether the pattern was likely to be repeated, I would have answered with a firm "no". The involvement and resources necessary to produce colour receivers, and / or to market them, are far greater than for their monochrome counterparts. And surely the memory would still be fresh of the many firms which prospered and then failed in the early sixties.

But I have had to revise that opinion in the face of reports, from various parts of Australia, of small groups which plan to make a quick killing with a few hundred or a few thousand colour receivers, imported, adapted, or manufactured from whatever parts that can be obtained. With a wide open market and with overheads kept to a minimum, there is seemingly money to be made.

In a free enterprise society, such aspirations are legitimate and I could not condemn the small man who seizes an opportunity to make good. Nor does this magazine have any special brief for — or vested interest in — established manufacturers and importers for their own sake.

What is disturbing is the likelihood that many small-scale ventures will be short term only, leaving behind a whole new array of orphan sets.

But, this time, they will be colour sets, vastly more expensive and complicated, and a patchwork of components and technology more international than local. This time, there won't be back-up sources for replacement parts, nor a small army of technicians-cum-servicemen to perform a rescue operation.

For members of the public, it will be a poor bargain to obtain a colour receiver promptly and cheaply, only to find later that it will cost a small fortune to keep going. As colour sets begin to appear on the market, prospective buyers should think beyond the present to the inevitable day when it will need repair. Then what?

—Neville Williams

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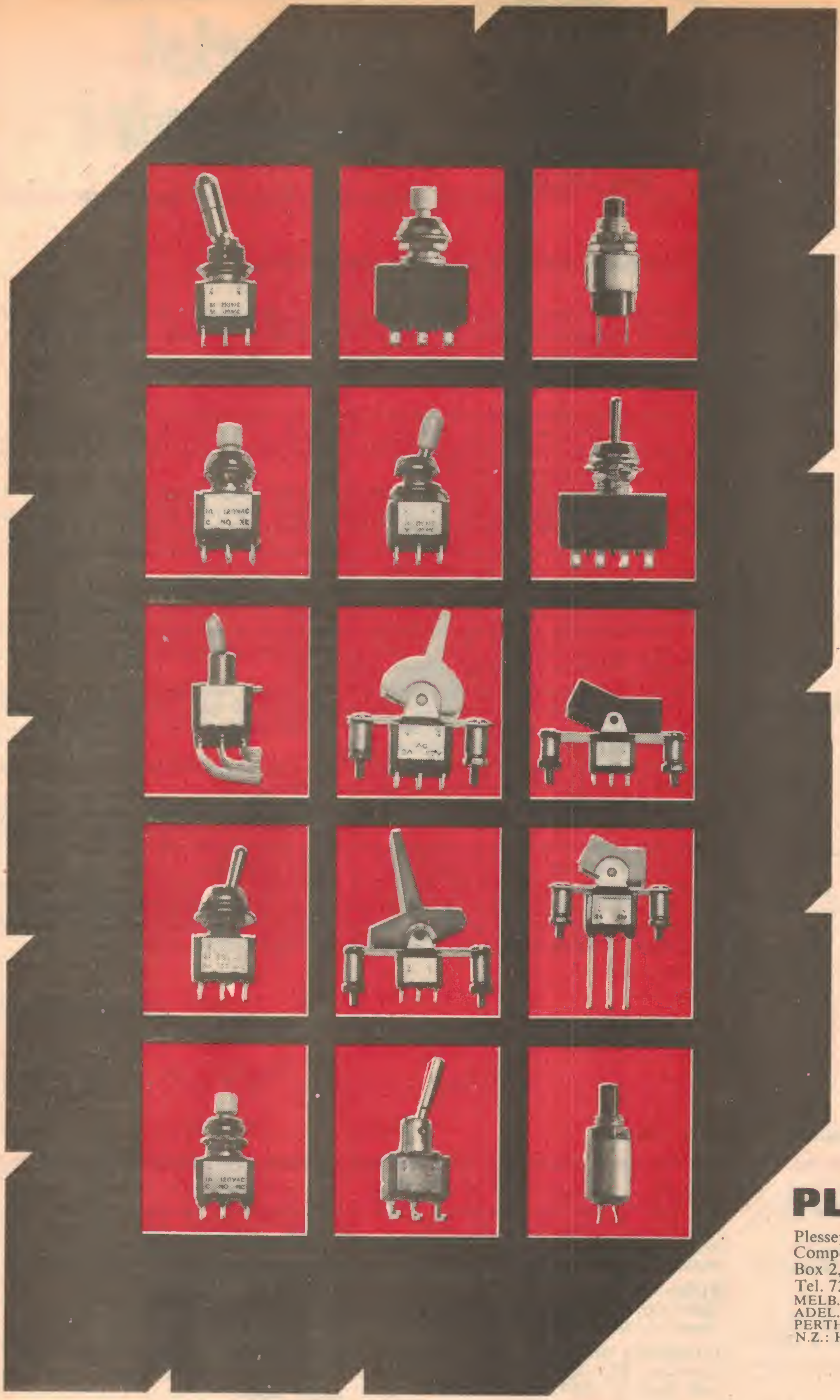
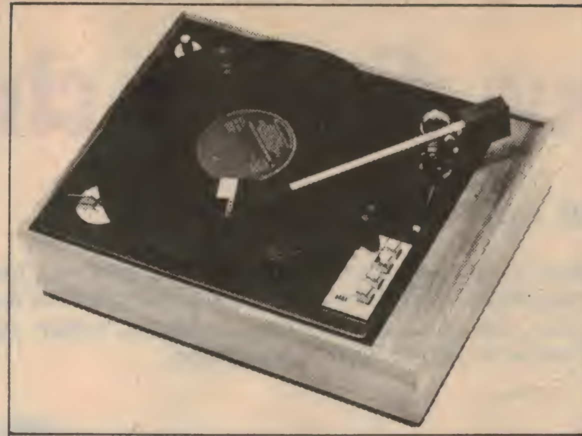


9 a.m. Monday, April 2nd, 1973.

6,160 hours later:
Wednesday, December 26th, 1973.



The Sceptics gave up.

Choosing the right turntable is extremely important. You want it to give first rate reproduction, to look good, to be reliable, and to not wear out your records.

The people at Sutherland Sound Fidelity Centre were a little sceptical about our reliability and non-record-wear claims.

Over 8 months of 1812

So they took the Elac Miracord 50HII turntable, put it in their window tilted at a 40° angle for display (incidentally, they thought it would make the turntable work that much harder) and started to play Tchaikovsky's 1812 Overture.

The turntable was set on automatic replay so it played continuously.

They sat back and waited . . . and waited . . . and waited . . .

Eight months and three weeks later, they'd had enough Tchaikovsky to last them a lifetime.

They were tired of waiting for the turntable to fall apart and decided the point had been proved.

A Lifetime's wear and tear

The Elac turntable had played one side of the 1812 Overture 21,120 times, at an angle of 40°, for 6,160 hours. Continuously.

The platter had revolved 12,318,768 times. The Elac's motor rotor had revolved 554,400,000 times.

The Elac turntable had gone through more than a lifetime's wear and tear, yet the mechanism was in surprisingly good condition. And, whereas lesser motors would have burnt out long before, the Elac motor showed very few signs of the gruelling test.

No grumble from the grooves

The record and the 50HII were then sent to Louis Challis and Associates a NATA laboratory, and internationally recognised authorities on the testing of hi-fi equipment.

Their verdict: the record showed a remarkably low level of wear — consistent with what they expected to find for a record having been played less than 200 times and certainly not over 21,000 times. Proof that an Elac will not wear out your records. Secondly, after a mere change of the idler wheel, the turntable almost met its original specifications. Proof that an Elac Turntable will give you the ultimate in reliable performance.

So if your a little sceptical about turntables — choose an Elac.

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Sutherland Sound Fidelity Centre.

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MCG.8

Our reaction to CD-4: four dinkum channels, but . . .

by LEO SIMPSON

A couple of weeks ago we sat down with a powerful four-channel receiver from Kenwood and two of the latest CD-4 cartridges from Audio Technica. This article gives our reactions to these products, which represent the latest developments in high-fidelity reproduction.

As long ago as October 1970 the Victor Company of Japan (JVC) introduced the CD-4 "discrete" four-channel stereo system, at the autumn meeting of the Audio Engineering Society in New York. Matrixed four-channel sound came at around the same time, and the waves of the resultant four-channel revolution are still building up nearly four years later.

While many experts concede that matrix four-channel sound is just a transitional development, it seems that discrete four-channel sound is here to stay. Funnily enough, the greatest acceptance (or success?) of four-channel equipment has been with the layman. He has gone to his local department store, had the latest and the greatest (4-channel) sound system demonstrated to him by the eager salesman and bought it.

And it would seem that generally he has been pleased. After all, the "sound comes from the four speakers, doesn't it?" and that's good enough for him. The fact that there are as yet not all that many four-channel records available has not worried the layman at all.

But acceptance of four-channel sound amongst the high-fidelity enthusiasts has been much slower, as they have apparently adopted a "wait and see" attitude: wait and see what CD-4 is like. Sure, many people have built four-channel amplifiers with matrix decoders, or bought them. But generally with a view to being able to add a CD-4 decoder, if and when that system became the successful standard.

Well, four-channel equipment with full CD-4 replay facilities has been available in Australia for about a year now. And like many people, the staff at EA have been present at demonstrations of CD-4 equipment, but it was only recently that we had the opportunity to set up a full CD-4 system in a home situation.

The equipment was a mixture, not a fully integrated system by a single manufacturer. Four modern two-way loudspeaker enclosures were set up, and although those in the "front" had a somewhat higher performance than those at the back, both pairs of loudspeakers were certainly capable of giving a fine stereo performance by themselves.

The record player was a modern belt-drive unit with anti-skating compensation applied to the tone arm. This is very important if correct tracking conditions are to be met. At the same time, the signal cable from the player was fairly short, so that cable capacitance is kept below the accepted maximum figure of 100 picofarads. Capacitances higher than this cause undesirable losses of the 30kHz carrier.

To provide signal amplification, we had the newly-released Kenwood KR-9340 four-channel receiver. And you just don't put this piece of equipment anywhere. It won't sit on your average bookshelf — it is too massive for that. Dimensions are 534 x 162 x 418mm (W x H x D) and weight is 21.1kg. In fact it was quite a bit larger than the record player deck it was used with.

Power output of the KR-9340 measures 45 watts per channel, with all channels driven. So it is not at all like earlier four-channel amplifiers with power output of only 10 to 15 watts per channel. In fact, the KR-9340 gives very little away in specifications to some of the finest stereo receivers around today. As a bonus, it has a fine FM stereo tuner inbuilt, which hopefully will be able to be put to serious use in the next few years.

When the power is applied, the dial lights up to reveal no less than six meters(!) and the FM and AM band calibrations plus a logging scale. In addition, the dial pointer lights up in red when the tuner is in operation. And an appropriate window is illuminated to indicate the mode of reproduction: CD-4, SQ or whatever. Two of the meters are for FM and AM tuning, while the other four indicate signal levels in each channel.

Three large knobs are provided for Tuning, Selector and Volume. Below these are four knobs which provide selection of the mode, and balance between front and rear and left to right channels. Below these again are four small knobs which provide bass and treble controls for the front and rear channels. In spite of having eleven knobs and ten push-buttons on the front panel, the unit is relatively easy to drive. All controls have a good feel about them as can quite rightly be expected.

As can be imagined, the internal details of the receiver are very complex and considering the amount of circuitry involved, probably rival the complexity of a full size colour television receiver. The power supply is impressive, with a large black power transformer and two filter capacitors of no less than 15,000uF each at 50V rating.

An important part of the system is the Kenwood CD-4 system disc demodulator, with the type number KCD-2. This is an optional plug-in unit which can only be used with Kenwood four-channel receivers. It has a large printed board measuring approx 240 x 110mm. This accommodates a complex circuit comprising two phase-lock-loop integrated circuits, 26 transistors and 13 diodes.

Some of the features of the KCD-2 demodulator are an automatic switching circuit to change over from CD-4 to conventional stereo records, an automatic noise reduction system and a CD-4 "Radar" circuit. More about this latter feature later. Four knobs are provided on the demodulator for adjustment of 30kHz carrier levels and separation between front and rear channels. A special 7-inch record is provided to make these adjustments.

By this time, the reader should be getting the message that setting up a CD-4 system is not a mattter of just hooking up a few wires and then sitting back to listen to glorious music.

A large slot is provided on the rear panel of the receiver to accept the plug-in demodulator. When the demodulator is plugged in correctly it allows the CD-4 indicator to light up when that function is selected.

When a CD-4 disc is being played, a window marked "Radar" lights up on the dial to indicate that a 30kHz carrier is present. We feel that some term other than Radar should be used for this function. After all, in many cities of the world stereo amplifiers are subject to radar interference!

Incidentally, there is a socket on the rear panel of the receiver for the FM detector output. This is for use with a broadcast four-channel adaptor if and when such a device finally becomes available. (Four-channel reproduction is certainly becoming complicated, with discrete, RM, SQ, CD-4 and now the probability of FM four-channel broadcasts!)

Three cartridges were involved in the listening tests. One, a good quality stereo magnetic fitted with elliptical stylus and tracking at around one gram or less. This and the loudspeakers were the known quantities in the system, having been listened to over a period of years. The other two cartridges were the Audio-Tecnica AT-15S and AT-12S, which are specifically intended for CD-4 reproduction.

We set up the system with the stereo cartridge first and listened to a few well-known stereo discs, to familiarise ourselves with the sound of the system. This was all that it should be, with plenty of power in reserve, even when playing at a really loud level.

With loudspeakers of a moderate power rating, one should treat the tone controls with respect when listening at high sound levels. The range of bass boost is quite generous and could overload loudspeakers if they are used carelessly.

With all controls set for fairly loud sound levels and with the pickup off the record, residual noise from the loudspeakers was commendably low. And there was a complete absence of clicks and pops due to refrigerators, electric frying pans and other electrical appliances.

Yet surprisingly the silence was marred by a hum from the power transformer itself. This was quite noticeable and would be cause for legitimate complaint from any buyer. We were later able to effect some improvement by tightening the screws on the transformer end-covers.

A feature we feel could have been included in the KR-9340 is the ability to play in "Double Stereo" which allows you to play the unaltered stereo program through the rear loudspeakers. This means that when playing stereo records, independent level control can be exercised over two different sets of loudspeakers in different rooms. As such it is a handy feature, especially at parties where the "swingers" want the sound loud while the oldies want it subdued. (This assumes of course that the two groups can abide the same program.)

At present, when the mode switch selects "Mono" the same program is radiated from all channels at the same level, but in the "2CH" position, the rear loudspeakers are silent.

Listening tests were then made with quite a few SQ discs. As in the past, we noted that SQ can certainly add an extra dimension to popular instrumental records, provided that the rear loudspeakers are not at an obtrusive level. Cymbals are particularly enhanced by this mode.

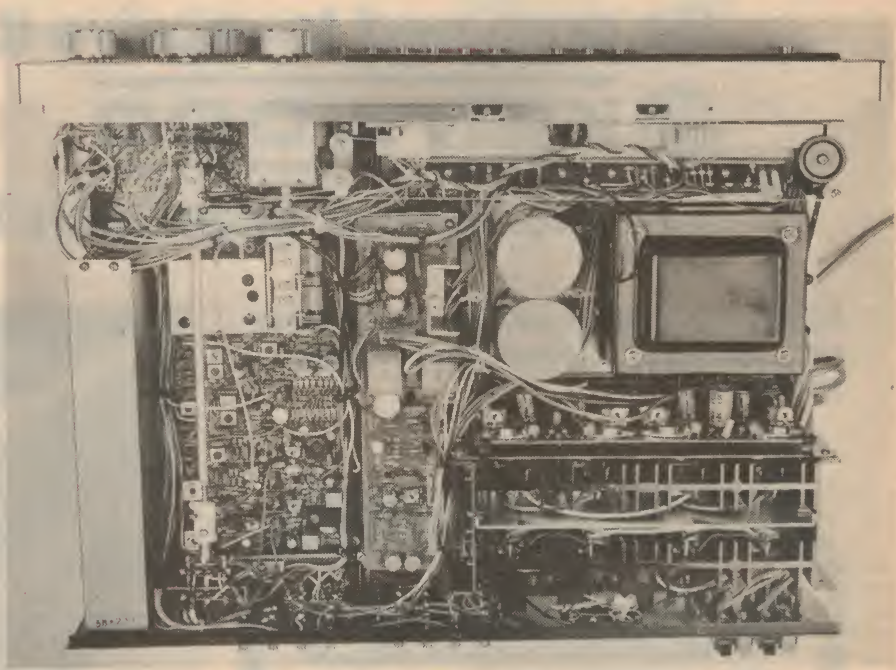
However, solo instruments and vocalists can tend to take on a disjointed, ethereal quality which can be annoying as you wonder just where the singer is. And complex choral and orchestral works seem to suffer in definition because the directional quality of the music is made less definite.

Kenwood also have RM (Regular Matrix) decoding in this receiver. RM decoding provides a good compromise for recordings made with the Sansui QS method.

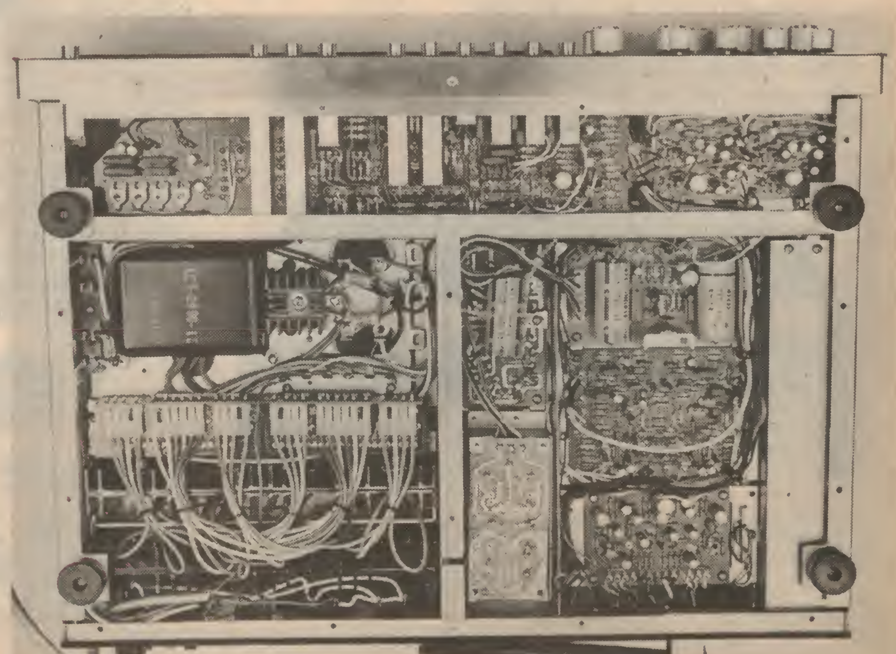
There is no quadraphonic simulator position as such on the mode switch of the receiver, to enable ordinary stereo records to be enhanced in four-channel mode. Instead, the Kenwood instruction manual recommends the RM mode for this purpose. Actually, the SQ mode can be used for this as well and you can use whichever mode seems to provide the best effects with particular records.

And now to CD-4. The two cartridges made by Audio Tecnica are interesting in that while at first sight they are quite similar to a conventional cartridge, closer observation shows them different in several respects. First, the removable stylus assembly is pulled straight down and slightly back to remove it rather than being pulled out along the major axis of the cartridge as in conventional induced magnet models.

Moving magnet operation is employed. Two very small magnet arms are attached to the stylus cantilever, mounted at 45



Above is the topside and below is the underside of the Kenwood KR-9340. The housing at one side of the chassis accommodates the plug-in KCD-2 demodulator.



degree angles, ie, effectively perpendicular to the groove walls. With its associated pole pieces and coils each magnet reproduces only the signal from one side of the record groove. This method of operation is claimed to maximise channel separation.

With the smaller magnet structure, the signal output from the cartridge is down only slightly on the very best stereo cartridges which generally have an output of about 0.7mV / cm / sec.

The stylus cantilever itself is markedly smaller than that for a conventional stereo cartridge and is tapered so that its effective tip mass is considerably reduced. This is essential if the stylus is to be able to track the supersonic components of the groove modulation, which extend up to 45kHz. The stylus is what Audio Tecnica term a "Shibata nude diamond." This bears some explanation.

The Shibata stylus is a modified elliptical type with a significantly larger shoulder radius to effectively increase the groove contact area, while still maintaining the ability to trace the fine modulations. The increased groove contact area means that, while the normal stylus tracking weight of 1½ to 2 grams is higher than for the best quality stereo cartridges, the actual stylus pressure is reduced. The result is less wear and tear on both stylus and grooves.

"Nude diamond" refers to the fact that the stylus is made from a solid diamond shank rather than being a chip of diamond mounted on a steel shank. Needless to say, the stylus is the most expensive part of the cartridge.

Both cartridges are supplied with a full set of hardware including a small screwdriver, stylus cleaning brush and various mounting screws. The owner's manual is well written and leaves the user in no doubt as to how to operate his cartridge for the best reproduction. Cleanliness of records is emphasised and Audio-Tecnica caution against the use of record cleaning sprays as they tend to clog the grooves.

Cartridges and replacement styli are guaranteed for one year from date of purchase against defects in workmanship and materials. Naturally, the warranty does not cover stylus wear or accidents such as bending the stylus at a right angle. The manufacturers recommend that the stylus be inspected by the dealer at least once a year.

We first tried out AT-15S, which is the more expensive model. After carefully setting the arm balance and anti-skating, we adjusted the KCD-2 demodulator with reference to its instructions and using the supplied 7-inch 45rpm record. While labelled Kenwood, this record is actually mastered and cut by JVC.

A series of warble tones are used to adjust separation and 30kHz carrier level. Clear voice announcements identify the tracks. On the announcement "front left channel" you adjust one of the knobs to null out the rear left channel. The same then goes for the right channels. The 30kHz adjustment is done by first turning the two appropriate knobs fully clockwise. Then, listening to the warble tone, the knob is backed off until a sudden change is heard in the warble tone. The knob is backed off further by one calibration. The adjustments are repeated for the other channel.

Finally, at the end of Side 1 of the record a bland, matter-of-fact voice announces "Front right channel, Rear right channel, Front left channel, Rear left channel." And there it is, very positively coming from the correct places! No ambiguities whatsoever. There is at least 20dB separation between all channels (we estimate). In a later article we should be able to give detailed measurements.

On music, the system is hard to believe. After listening to the subtle effects of SQ and other matrix methods, CD-4 hits you with all the subtlety of a sledgehammer. There really are four discrete channels. After years of marvelling at the ingenuity of the stereo record, it is hard to accept that the same groove can provide four channels.

And the quality is good. Not only is the separation between channels at least as good as with four-channel tape systems, but the noise is lower. And the music is clean and wide range, with transients hard and clear. Fortunately, the discs do not repeat the exaggerated "ping-pong" effect of early stereo records. Ping-pong effect is bad enough with a stereo set-up, but with four channels it could be exhausting.

By comparison with the best currently available stereo records, the records we listened to tended to have a strident string tone and emphasised bass. But we have noticed this tendency with some Japanese records anyhow, so we are not inclined to blame the CD-4 techniques for tonal errors. At any rate, on conventional stereo records, the AT-15S gives a very good account of itself.

As a side issue, readers will have noted that in January of this year in the Hifi News pages of this magazine, we published a letter from James H. Kogen, vice-president of Shure Brothers Incorporated. In this, Kogen states that two separate cartridges should be used to get the best reproduction from the two mediums of stereo and CD-4. Our own observation is that a fine CD-4 cartridge such as the Audio Tecnica AT-15S can probably play both with little loss. And the effectively reduced stylus pressure of the Shibata stylus means that stylus and groove wear probably equals that of the best stereo cartridges.

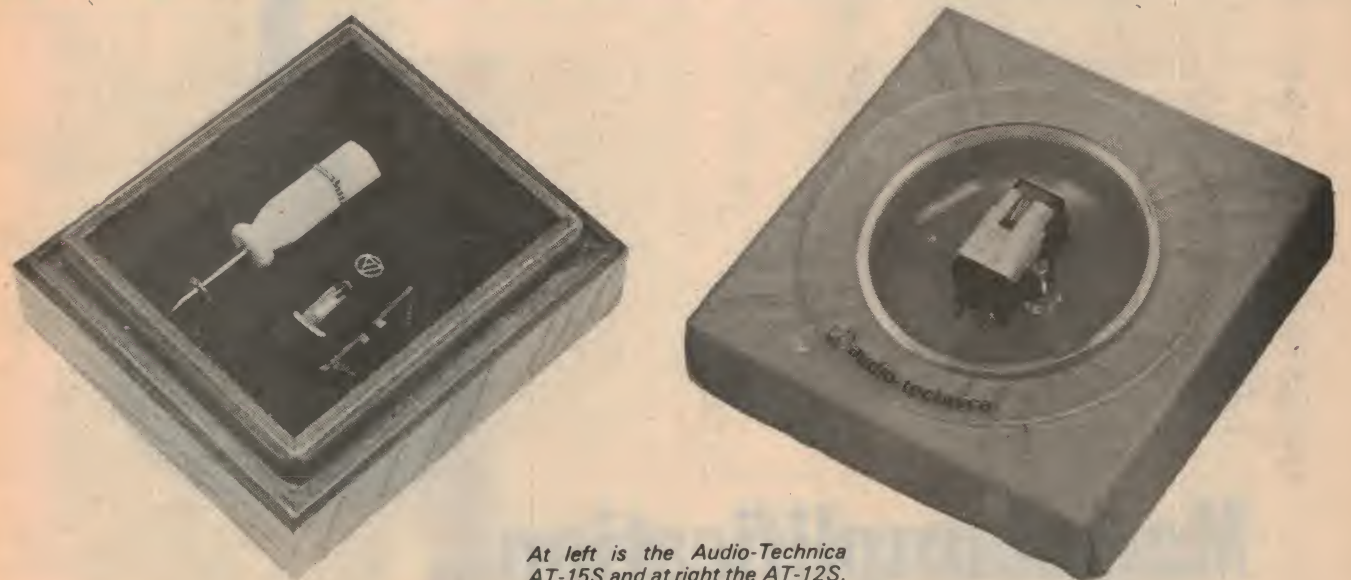
Comparisons were made between the AT-15S. and the less expensive AT-12S. Generally, the differences were subtle. The AT-12S is less clean and does not reproduce transients quite so well. For most people, though, the AT-12S will be a viable alternative considering its lower price.

So four-channel reproduction via CD-4 is a reality, both technically and commercially. At this stage, there are still relatively few CD-4 records but that situation is changing. Whether the system becomes fully accepted by dyed-in-the-wool stereo enthusiasts accustomed to the traditional "stage" presentation of classical music remains to be seen. That may also depend on the composers and the recording companies.

For those who have already decided in favour, the Kenwood KR-9340 four-channel receiver must be a good place to start. It's right at the top. Recommended retail price is $899, while the optional KCD-2 decoder is $120. Less expensive Kenwood models are the KR-8340, KR-7340 and KR-6340.

At the time of writing, we cannot quote the prices of the Audio Tecnica CD-4 cartridges.

For further information regarding Kenwood and Audio Tecnica equipment, enquiries should be directed to high-fidelity retailers or the Australian distributors, Jacoby, Mitchell and Company Pty Ltd, 215 North Rocks Road, North Rocks, NSW.



At left is the Audio-Technica AT-15S and at right the AT-12S.

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SON 2

SONAB:

Loudspeaker design

. . . A SCIENCE, AN ART OR BOTH?

Basis of the new Sonab range of loudspeaker systems is this SC165 driver, with a nominal diameter of 165mm (6½ins). It has a large long-throw voice coil and a cone surround of foam plastic, especially designed to optimise its operation in a reflex enclosure. Intended frequency range extends to 3000Hz.

A new range of loudspeaker systems, recently announced by Sonab of Sweden, maintains the broad approach evolved by Company founder Stig Carlsson. While the Sonab systems look quite different physically from other brands, the basic design philosophy has a good deal in common with that put forward by Professor Amar Bose, and reported in our March issue.

At a recent audition of the new range, Australian manager for Sonab, Derek Pugh suggested that "Electronics Australia" readers may be interested in an article which sums up Stig Carlsson's design concepts. It emphasises the subjective aspects of loudspeaker reproduction and considers how loudspeakers should be evaluated in terms of their suitability for use in actual listening situations.

SONAB VIEWPOINT:

For a long time the design of loudspeaker systems has been surrounded by an aura almost of mysticism. Many strange constructions have emerged, many of them founded on tradition, rather than sound knowledge. The designers have had one thing in common: each has had his own ideas on how a speaker should sound and, of course, his own particular model was bound to sound just right!

During recent years, however, there has been a tendency to devote more attention to science and technique rather than tradition and inventiveness, though this does not mean that our knowledge of the subject is complete. In the 1973 Stereo Hi-Fi Handbook Ulf Rosenberg of Sweden's National Institute for Materials Testing writes:

"Unfortunately we know all too little about how different physical parameters for speakers affect the way in which we experience speaker sound. There still exists no method for assessing physical parameter measurements and thus producing a grade or a value corresponding to the subjectively experienced sound quality."

Thus, when appraising a loudspeaker, our own listening impression tends to be the determining factor.

Perfect reproduction of music makes great demands on all the equipment involved in a system, one of the problems being to maintain a flat frequency response.

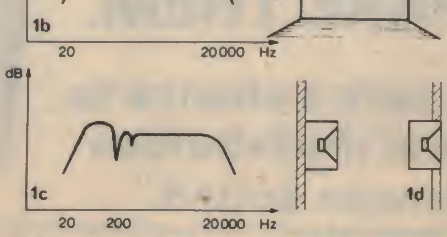
The frequency response of amplifiers can be held within narrow limits, typically 1dB or less, but loudspeaker systems are a very different proposition. As heard in the average listening room, it is difficult to avoid discrepancies of as much as 10dB! Some of the problem has to do with the difficulty of measuring loudspeaker output in a representative manner.

With amplifiers there is never any question as to what and where one shall measure. The input signals are compared with the output signals; a fairly simple procedure.

But in the case of a speaker the procedure is more complicated. Just where should the measuring microphone be placed, and the speaker too, so as to produce a result which demonstrates the speaker's qualities in normal circumstances?

The frequency response of a loudspeaker system depends upon its position in relation to the adjacent walls. A speaker designed for a flat frequency response in an anechoic room, figure 1a, (a special acoustic measuring room where all the walls are sound-absorbing) produces a bass boost of 2-3dB at 100Hz if the speaker is mounted on the wall of a living room, figure 1b; furthermore if the speaker is placed in the corner the bass boost is three times as great, (8-9dB).

This is because at low frequency a speaker emits sound not only forwards but in all directions, including backwards. Walls in the vicinity and likewise ceiling and floor reflect the sound and influence efficiency. When the distance of the sound source from the reflecting surface is less than one fifth of the sound's wavelength the efficiency increases. When this distance is less than one tenth of the wavelength the increase amounts to 2-3dB per reflector, ie about 5dB for a position near both walls and so on (the sound wavelength is 3.4m at 100Hz and 6.8m at 50Hz).



If a system with a theoretically flat response in free space (1a) is placed close to a flat surface (1b) a bass boost effect will result. Merely against the surface may produce a dip as well (1c).

It is evident enough that, when taking measurements, reflecting surfaces should be included to an extent that corresponds to normal positioning of the speaker. Yet if even one wall is added during measurement, difficulties arise: at a certain frequency the distance between the direct and the reflected sound will amount to half a wavelength. The direct sound is cancelled out by the reflected sound and a primary dip occurs in the frequency response (figure 1c), usually at 200 to 400Hz, with smaller dips at frequency multiples.

In order to avoid this dip during measurement, the speaker can be let into the wall so that the front side is flush with the wall surface (figure 1d). This procedure which does not give proper results in relation to a normally positioned speaker has, in fact, been standardised in the German Hi-Fi norms DIN 45,500!

Measuring the frequency response of a speaker in an anechoic room might give speaker designers a certain amount of information. But it is misleading to suggest to the customer that such frequency response is representative of the speaker's performance in normal conditions.

If the frequency response for direct sound from the speaker is not representative of the frequency balance experienced when listening in a normal living room, then how can one measure performance?

Before seeking to answer this question, it is necessary to understand two important points:

1. The way in which the hearing functions: In a rapidly changing sound field the direct and reflected sound is integrated within an interval of 30-50 milliseconds.

2. Reverbation: With the reverbation time in a normal living room (less than one second) and a listening distance of 2-3 metres the reverberation will dominate the direct sound over part of the range with most loudspeaker systems, the exceptions being those which are extremely directional.

jensen

MODEL 1

"GREAT FOR FOUR CHANNEL" (or any stereo system)

AVAILABLE FROM

QLD:
Reg. Mills Stereo — Buranda 91 1089.

NSW:
Allied Music Systems — Crows Nest 439 1072.
Audio Gallery — Warringah Mall 938 2205.
Dyna Stereo — St. Peters 51 7071.
Fidela Sound — Summer Hill 799 2618.
Insound — Crows Nest 929 2714.
Instrol — Sydney 29 4258.
Kent HIFI — Sydney 29 6973.
Magnetic Sound — Sydney 29 3371.
Wests — Burwood 747 4444.
Dynamic Sound — Newcastle 21-188.
Audio World — Wollongong 295-110.
HIFI House Wollongong 286-661.
Pee Jay Sound Centre — Broken Hill 7303.

ACT:
Plaza HIFI — Woden 821-499.

VIC:
Douglas Trading — Melbourne 639-321.
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Here's 4 good reasons:—

1 **PERFORMANCE** — Fabulous! A power handling capacity of 30 watts, and yet an efficient system. A frequency response of 40-18000Hz, an impedance of 8ohms to really suit low cost solid state amplifiers, and a dispersion angle of 120° of the high frequencies.

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4 **PRICE** — Would you believe $99 a **PAIR**! That's right.

FOR BETTER OR WORSE, COMPARE THEM.

Give your ears a chance to appreciate the fabulous $99 Jensen sound.

AUSTRALIAN DISTRIBUTORS:

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SONAB: "New generation"

Externally, the loudspeaker systems in the Sonab "new generation" series are similar to those they supersede and the basic design principles also remain unchanged. There are internal differences, however, the most obvious being in the use of Sonab's own SC165 woofer, as pictured on the preceding page.

Baby of the new range is the OD11, a 26cm cube, with an internal volume of 10 litres. It employs one SC165 driver for bass and mid range, and a 5cm dynamic tweeter for the high frequencies. Power input for an acoustic output of 0.022W (DIN) is 8W, with a maximum power handling capacity of 40W (DIN). Rated frequency response is 52-15000Hz within limits of plus and minus 4dB. Fed with a high quality signal, and resting face-up on a carpeted floor, the OD11 produces a sound that seems out of all proportion to its size, in both level and quality. Because it is so compact, the OD11 can also be used on shelves with a variety of orientations to direct the sound for best stereo advantage.

The largest of the three is the OA14, measuring 23 x 57 x 42cm, with an internal volume of 35 litres. It uses the same SC165 main driver, but associated with four 5cm tweeters, angled in various directions to disperse the treble for a high degree of reflected sound. The power ratings are the same as for the OD11, but the larger dimensions extend the effective frequency response to 29-15000Hz within limits of plus and minus 3dB. The sound is smooth and pleasant and, while the general balance is similar to the small unit the extended bass is unmistakably there for the music that requires it.

In the middle of the range is the OA12, 20 x 46 x 34cm and 18 litres, with one SC165 driver and two tweeters .Power handling is again the same and the rated bass response ends up at 42Hz for 3dB down. General balance and sound is similar to the other two and its appeal would be for situations which dictate a free standing unit of intermediate size. We suspect, however, that having opted for an upright system as distinct from the diminutive OD11, most customers will pay the extra for the OA14.

All units are sold in matched pairs, in teak, oak, walnut, rosewood, or white and black lacquer.

This means that it is the frequency response for the speaker's total sound flow which is representative of the frequency balance that is experienced.

There are in principle two different means of measuring a speaker's total sound flow.

One is a special integration procedure in an acoustically free field.

The other is a measurement of the total radiated output from the speaker in a reverberant room.

As early as 1958 Stig Carlsson developed the first of these measuring methods, the integration procedure, as an aid in the designing of speakers. Due to this it has been possible to build Sonab speakers so that they have very flat frequency response in quite ordinary living rooms with normal furnishings.

With funds provided by the National Consumer Goods Research and Information Department a measuring method using a reverberation room has been established at the National Institute for Materials Testing. This advanced measuring method has been recommended as a standard procedure in Sweden and is used as a basis for the reports on speakers in the Stereo Hi-Fi Handbook mentioned earlier.

However one problem remains to be solved:

Measurements in a resonant room do not ensure sufficient accuracy in the bass range. It is in the bass range in particular where the speaker's output is influenced by adjacent surfaces. Thus the data must be supplemented by measurements made in an anechoic room, with due allowance for the subsequent likely effect of reflective surfaces in actual listening rooms.

In fact, the impressions derived from listening are substantially affected by the relationship between direct and reflected sound.

Direct sound is that which reaches the ear directly from the sound source, while reflected sound reaches the ear only after it has been bounced back off the walls, ceiling, etc. The auditory faculty handles reflected sound in different ways. The primary reflected sound picked up by the ear 30-50 milliseconds after the direct sound is heard as part of the direct sound itself. The secondary reflected sound is heard as reverberation.

In order to create spatial, vital reproduction one has to consider the primary reflected sound, during both recording and reproducing. Speaker designers must see to it that not only the direct sound, but also primary reflected sound from walls and ceiling, reaches the listener.

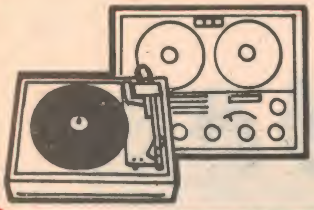
The primary reflected sound in a room depends partly upon that room's acoustical properties and partly upon the directional qualities of the speaker. In the treble range a conventional speaker gives far less primary reflected sound than does the omnidirectional speaker.

The usual position for a speaker is against a wall and thus logically the best way to design a speaker is to ensure that it collaborates acoustically with that wall.

A spatial experience of sound is greatly influenced by the treble's paths of propagation in the room.

A conventional speaker with the speaker element itself installed in the front produces a distinctly "unnatural" directional impression. This is because the treble register produces very little primary reflection, especially from the wall behind the speaker, even if one uses what is known as a dome-tweeter. In stereo reproduction this means that one loses the feeling of spatially vital reproduction, in addition to which the listener is tied to one particular position in the room.

The Sonab omnidirectional speaker gives a more even, directional distribution of the primary reflected sound and in stereo reproduction the listener enjoys a wider choice of listening positions.



Hi Fi News

Pioneer: 4-channel sound for cars

Stereo sound has become commonplace in new cars and most will agree that it provides far better listening than from the one-time single loudspeaker tucked away behind the facia. But Pioneer are encouraging motorists to go one step further and to install a full-scale quadraphonic system fed from cartridge tapes.

The new Pioneer quadraphonic tape player QP-444, illustrated above, is extremely compact — 181(W) x 60(H) x 174(D) mm — and should fit in the space normally allocated for an ordinary 2-channel player. It will accept 8-channel tapes, either two programs in quadraphonic or four programs in normal stereo. The act of inserting a cartridge activates the unit, withdrawing the cartridge switches it off. Easy-to-use controls provide for track selection, separate front and rear volume level, left-right balance, and tone.

Employing eight integrated circuits, the QP-444 player can deliver an output of 3.8W RMS per channel, with a rated signal/noise ratio of 45dB and a rated frequency response from 50 to 10,000Hz. These figures would, of course, be dependant on the quality of the tape program and the performance of the loudspeakers installed in the vehicle.

In fact, three new loudspeakers have been announced simultaneously with the QP-444 player. The TS-690 illustrated below is a twin-cone 9 x 6in oval unit, with matching perforated face plate and normally selected for mounting beneath the rear shelf. In the centre is a 6½in twin-cone unit with a power rating such that it will handle any likely signal from a tape player. Intended for mounting in door panels, the speaker has a matching anti-scuff fret.

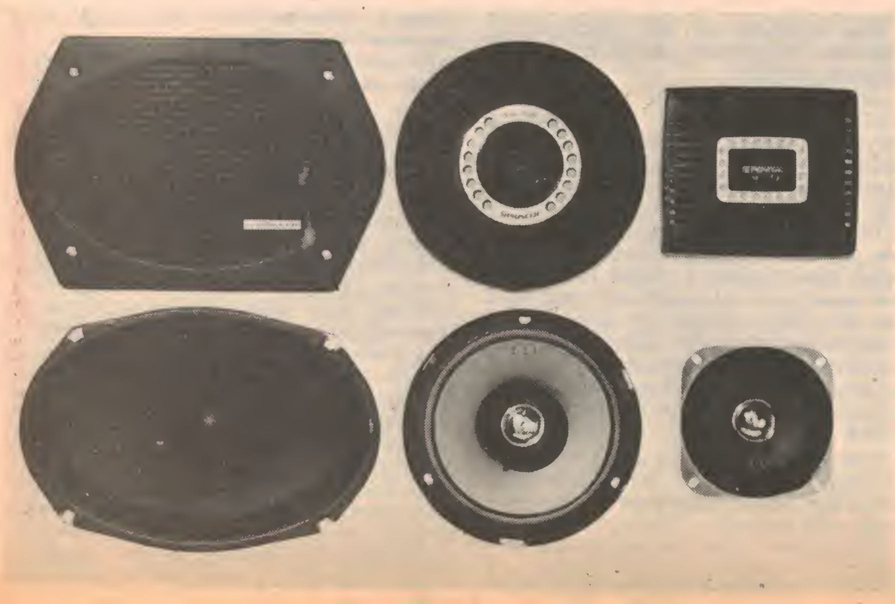
Where space is at a premium, a 5-inch twin cone model is available, as illustrated, with a rectangular anti-scuff faceplate.

On the domestic front, Pioneer have superseded their popular SE-20A headphones with a new model, the SE-205, as illustrated. The matte black earcups have been re-shaped and accommodate an improved 70 mm cone speaker, which offers better bass response and a treble response

now claimed to extend to 20,000Hz. Recommended retail price for the new headphones is $17.00.

The other new line is an attractively priced loudspeaker system rated to handle 20 watts and retailing for $74.00 each. A 20cm (8in) woofer handles frequencies up to the cross-over at 5kHz, where a die-cast aluminium tweeter takes over, extending the upper range to a claimed 20,000Hz. Impedance is 8 ohms.

Details of any of the products mentioned here can be obtained from Pioneer Electronics Aust. Pty Ltd, 256 City Rd, South Melbourne 3205. Branches in other capitals.



The Pioneer CS-R100 has an unusual two-tone fret. Dimensions are 270(W) x 470(H) x 216(D) mm and the all-up weight 5.3 kg.

HIFI NEWS

Design award for Aiwa recorder

For the second time in two consecutive years, Aiwa products have won the "Good Design" award from the Japanese Ministry of International Trade and Industry for outstanding quality in design, workmanship and performance.

The "G" mark for 1973 was conferred on Aiwa's pocket-size high-performance cassette tape recorder, the TP-747, in its category, following strict tests by a MITI-commissioned screening group of industrial designers and merchandise examiners.

Earlier, in 1972, a similar team had selected Aiwa's fast-selling radio / cassette tape recorder TPR 501 as bearer of a "G" mark in its category.

The "G" mark was initiated in 1957 to encourage Japanese industries to develop good design and quality products at reasonable prices. For the 1973 screening, more than 90 examiners from MITI's Industrial Products Testing Laboratory, a number of other national and public testing agencies, and 17 private testing organisations, subjected entries to two to three months' product testing.

Following that, MITI's supervisory experts conducted quality checks on selected products for reliability and durability. Aiwa's sturdily-built midget cassette tape recorder came out with flying colours.

The TP-747 is a palm-sized midget, yet is completely equipped with a full range of built-in facilities comparable with a larger model.

These include electret condenser microphone, automatic level control, tape counter, auto-stop, anti-rolling system and servo controlled motor — features appreciated especially for outdoor recording and conference use.

The TP-747 operates on four possible power sources — dry cells, AC power with adaptor, rechargeable battery (optional) and car battery with adaptor (optional).

Though small in size (6-1 / 32" x 3-7 / 8" x 1-29 / 32"), the midget produces an output of 600mW at the maximum and is equipped with an earphone jack, DC jack, remote jack and microphone jack.

Aiwa is currently marketing the TP-747 overseas under the catchword, "Ultra-Mini Type with a Jumbo's Performance."

Using 1 integrated circuit, 2 transistors and 3 diodes, the TP-747 has an output of 600mW, a rated response to 10,000Hz for a signal / noise ratio of 40dB. It measures 165 x 97 x 44mm and weighs 750g or 1.65lbs. For further information: Goldring Engineering (A'Asia) Pty Ltd, 26-28 Ricketty St, Mascot, NSW 2020.

ROLA: SUPER-THIN LOUDSPEAKERS

The Australian distributor for the Magitran Company of New Jersey, USA, Plessey Rola, has released a new range of poly-planar loudspeakers — superthin and highly decorative!

The range is quite extensive and provides speakers suitable for cars, boats and outdoors as well as indoor speakers suitable for decorative uses, or for installation in walls, ceilings, doors or furniture.

A series of 2" thin, decorator, sound panels is available which can be disguised as paintings or prints while being capable of working at power levels of up to 60 watts.

Smaller speakers, with a power handling capacity of up to 20 watts, are only ⅞ inch thick and can be mounted anywhere, being literally weatherproof, rotproof and tearproof — while still producing true Hi-Fi sound.

A large range of mountings and grilles is available to suit almost all imaginable uses for the speakers.

Detailed information about the new range is available from Plessey Rola Pty Ltd, The Boulevard, Richmond, Victoria, 3121.

A single chip decoder for CD4 discs

Singnetics Corporation has turned out its first production run of an integrated circuit that contains a complete four-channel high-fidelity sound demodulator and preamplifier. Designated as the model "QSI 5022," the circuit is the largest linear IC ever produced for the consumer electronics industry.

Developed for Quadracast Systems Inc of San Mateo (Calif), the circuit decodes four discrete channels of sound from a single "CD-4" high-fidelity disc recording. The result is a reproduction of music with concert hall realism.

Four-channel sound is expected ultimately to become the predominant mode for recording on 33-1 / 3 rpm discs. Two main methods are being used to encode four channels on the discs. One is the "SQ-type" matrix technique, for which equipment is already available, and the other is the "CD-4" technique, which is now entering production. The "CD-4" method is better than the matrix in terms of performance and channel separation.

Development of the "QSI 5022" is considered to be a major step toward proliferation of four-channel hi-fi equipment. The new IC permits makers of four-channel equipment to build systems that are smaller and less expensive than in the past. Most present-day hi-fi equipment is stereophonic, producing two channels of sound, but many are now being manufactured with four-channel capability.

Within the "chip" of the "QSI 5022" are two complete systems. One system is for the right pickup channels, and the other system is for the left-hand channels. Also included are input preamplifiers and output buffer amplifiers. The IC contains all the sub-system functions needed to demodulate a CD-4 disc. It handles the audio signal all the way from the input from the phono pickup to the output drive for a four-channel volume and tone control. The IC can be used either with a flat-response semiconductor cartridge or with an "RIAA" magnetic cartridge.

The preamplifier in the "QSI 5022" has two outputs, equal in level but different in phase by 180 degrees. Another section of the IC amplifies and limits the carrier signal which is fed to two other sections of the chip — a "phase-locked loop" FM demodulator, and a carrier level detector. The carrier detector mutes the difference between sub-system outputs, a feature which inhibits signal-feed when there is no carrier present.

The "QSI5022" is being manufactured in a 28-lead dual-in-line package made from plastic. Prices range from $4 to $9, depending on quantity. According to Quadracast Systems Inc, the device is being sold by Matsushita Electric Corp of America (Panasonic), which has exclusive marketing rights to the "QSI 5022" in North America and Japan.

The FM Signal

The FM band takes pride of place in this AIWA model TPR-105, which also covers the normal AM broadcast stations and one short-wave band. Associated with the receiver is a complete mono cassette recorder permitting the user to record and replay any program material he so desires — a popular activity among FM listeners overseas.

Having looked at the subject of FM broadcasting in general terms, it is now appropiate to set down some of the figures involved — the frequencies actually used by FM stations, their deviation with full modulation, the effective frequency response of the transmitted signal, and so on. Together, these set the pattern for the design of domestic FM receivers.

by NEVILLE WILLIAMS

Virtually all FM broadcast services currently operate in the VHF portion of the spectrum between the nominal limits 88-108MHz.

Not all countries with an FM service use the full band or even an unbroken segment of it and, in the past, this has been evident in some receivers and tuners, which have covered only the frequencies appropriate to the country of manufacture.

More recently, there has been a tendency to design all FM equipment for full coverage, for the sake of standardisation and with a view to potential export markets. For this reason, most receivers and tuners now on sale cover the full nominal band 88-108MHz and, in fact, it would not be wise to invest in one with more limited coverage.

To quote actual examples, tabulated data covering European VHF broadcasting arrangements list the basic channels from CH.2 on 87.6MHz to Ch.56 on 103.8MHz. The channels are spaced 0.3MHz apart but some stations are offset by up to 150kHz (0.15MHz) to combat local interference problems.

By mutual agreement, the basic high power services are distributed geographically and in terms of frequency to optimise their coverage. About one-third of these stations are currently transmitting in stereo. Over and above the high power services, a very large number of low power stations are in operation, serving the local needs in various countries.

In the United States, the full FM broadcasting band is divided into 100 channels spaced 0.2MHz apart and numbered from Ch.201 on 88.1MHz to Ch.300 on 107MHz. The channels are not employed uniformly across the nation, however. The country is divided into zones, each with a different pattern of band usage, and each involving different classes of station, with certain limits on power and aerial height and planned coverage. For example, commercial FM broadcasting is concentrated below 98MHz in Hawaii, and above 100MHz in Alaska.

In Australia, the present plan is to set up stereo FM broadcast transmitters within the limits of 88-108MHz, initially on frequencies and in locations where they will not interfere with television services in adjacent channels. Gradually, over a period of years, the TV allocations will be changed to clear more of the band for FM broadcasting. Thus, while Australian listeners should equip themselves with standard coverage FM / stereo tuners and receivers, their choice of stations will initially be limited to what can be accommodated in terms of frequency, power and coverage in their particular area.

FM SIDEBANDS

In the planning and allocation of FM services, a vital factor is the bandwidth or spectrum space occupied by an FM signal. This is very much wider than the space required by an AM station, where the sidebands extend to either side of the carrier frequency by no more than the modulation frequency. For example, an AM broadcast station transmitting on 1000kHz and radiating audio frequencies up to a maximum of 15kHz, would occupy spectrum space between 985 and 1015kHz.

On the other hand, an FM transmitter radiates sidebands which are governed both by the modulation frequency and by the degree of modulation (or carrier swing). If a high maximum modulation frequency is desired (in the interest of quality) along with large deviation (for best signal / noise ratio) the bandwidth required can become quite substantial by comparison with an AM system.

As an empirical guide, sidebands with significant amplitude (1pc or more of carrier level) extend to either side of the mean carrier frequency by the sum of the modulating frequency and the deviation.

On this basis, an FM station transmitting audio frequencies up to 15kHz and deviating up to 75kHz will effectively occupy a bandwidth 90kHz either side of the nominal carrier frequency, or a total bandwidth of 180kHz. These figures provide the logic for the frequency allocation plan in the USA which nominates channels 200kHz apart.

In actual fact, if an FM transmitter is fully modulated at 15kHz, sidebands would extend to at least 120kHz either side of the carrier frequency and therefore outside the allocated channel. However, the practical

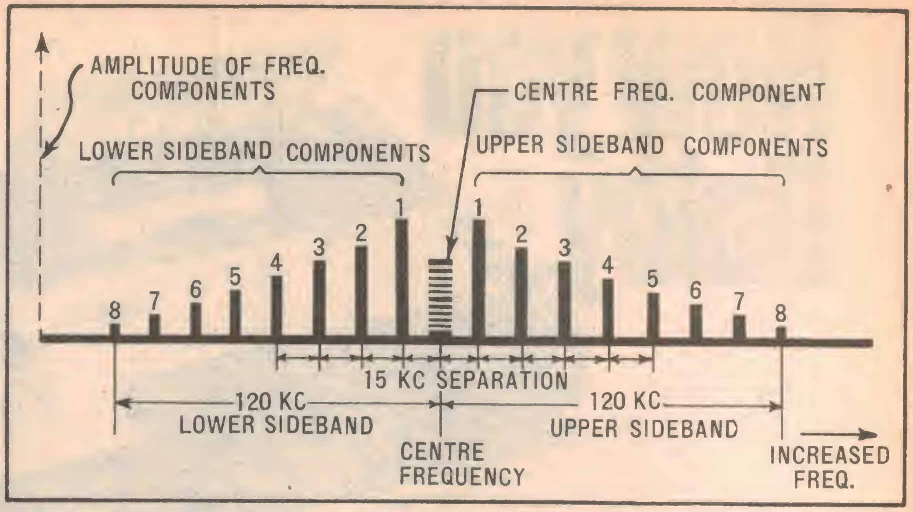
A typical AM / FM tuner currently available in Australia — the Sony ST-5066. While the dial is calibrated 88-108, actual coverage is 87.5-108MHz, thus including the European allocation on 87.6MHz. FM sensitivity is quoted as 2.2uV IHF or 1.7uV for 30dB of noise quieting. Signal / noise ratio is given as 68dB, as compared with 50dB for the AM section. Effective frequency response on FM is 30-15000Hz, for a distortion level of 0.5pc (mono) or 0.8pc (stereo) both for full modulation. Stereo separation is 35dB.

situation is that full modulation at these extreme frequencies occurs only rarely and no significant difficulties arise.

FM receivers must be designed — and tuned — so that they respond to the full range of sidebands, otherwise the recovered signal will suffer harmonic distortion, as distinct from a simple loss of treble in the case of an AM receiver.

One of the practical problems of FM receiver design is to achieve a pass-band wide enough to accept the full range of sideband frequencies, while discriminating against RF energy on all other frequencies.

For this reason, the number of stations which can be packed into a given amount of frequency space is not just a matter of the transmitter signal bandwith; it has much to do with the ability of receivers to reject signals other than the wanted one. It will undoubtedly be a significant factor in re-planning Australian allocations.



When a carrier is frequency modulated, a very large number of pairs of sidebands are generated that could extend well beyond the channel allocated to an FM broadcast station. This diagram, reproduced from an earlier issue indicates eight such pairs resulting from heavy frequency modulation of a carrier with a 15kHz tone. With typical program material, heavy modulation at 15kHz is less likely to occur but, on the other hand, a multiplicity of modulating frequencies will produce a veritable forest of sidebands. In practice most of these will concentrate within plus and minus 75kHz, sidebands beyond that having very small amplitude.

SIGNAL PROPAGATION

The antenna systems used with VHF FM transmitters are normally designed so that the signal is concentrated in the horizontal plane, more or less parallel with the surface of the earth. There is no point in radiating energy skywards, to be absorbed in the upper atmosphere or lost in space. If general coverage is required, the energy is radiated through 360 degrees; alternatively, directional properties may be designed into the aerial to reduce radiation in a particular direction.

Once radiated, VHF signals tend to travel in a straight line so that the coverage of a VHF transmitter may be thought of in broad terms as including all those points within line of sight of the actual antenna. If the ground surface was that of a smooth sphere, this would suggest a radius of about 80km (50 miles) from an antenna 400m above sea level, assuming a receiving antenna about 10m above sea level.

In fact, the surface of the earth is far from smooth and, in addition, the signal tends to be refracted somewhat by the atmosphere, so that it tends to follow the curvature of the earth. As a result, the signal may be received reliably beyond the expected limit, particularly in elevated receiving locations. Conversely, there may be areas inside the theoretical horizon blocked off from the transmitting antenna by intervening topographical features.

What level of signal is required at the antenna terminals to produce acceptable sound varies enormously with the receiver itself, with the local noise ambient and with what the listener regards as "acceptable."

Figures from Europe, relating to DX or long-distance FM reception, suggest that an acceptable mono program can be resolved from a signal as low as 2uV; this with a modern, well-designed tuner. More typically, the "threshold" for satisfactory mono reception is regarded as being between 10 and 20uV.

It is commonly accepted that a 10dB greater signal input is necessary to resolve a program in stereo, for a comparable signal / noise ratio. The 2uV figure would therefore multiply to 6, and the 10-20uV threshold to 30-60.

For "best possible" FM / stereo resolution, as distinct from "satisfactory", a desirable minimum is quoted as "towards 200uV."

In all this, transmitter power is a significant factor. While a weak signal will follow the same path as a stronger one, the difference would become apparent in areas where they were suffering attenuation due to distance or topography, or where they had to compete with a high level of interference of one kind and another. Obviously, the stronger signal would have the advantage so that, in practical terms, coverage is related to transmitter power, as well as to transmitting antenna height and site.

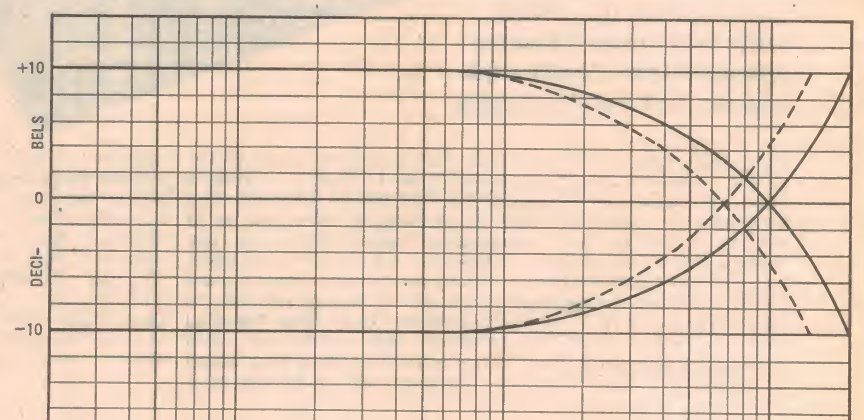
Australian television stations all use FM sound transmitters and the coverage of the sound signal — particularly from channels 3, 4 and 5 — can be taken as a rough guide as to what to expect from an FM transmitter radiating from the same, or a similar, tower. While, as stated, the effective coverage of a stereo FM signal may be less than that of the mono TV sound signal, it is reasonable to assume that this will be compensated by the performance of receivers designed with FM sound reception as a primary rather than a supplementary function.

POLARISATION

Also important is the polarisation of the radiated signal, or more expressly the polarisation of its electric component. From the listener's point of view, this has its most obvious expression in the physical mounting of the ordinary television receiving antenna.

By way of example, most television transmitting antennas in Australia are so designed that they radiate the electric field of the transmitted wave in a horizontal plane — the signal is horizontally polarised. In keeping with this, most television receiving antennas are mounted with the

(Continued on page 23)



The pre-emphasis and de-emphasis curves for FM transmitters and receivers. The dashed lines represent the 75uS figure adopted originally for the system in USA, while the solid lines are for the 50uS time constant preferred in Europe. In fact, the latter is likely to become a world standard.

THE STANTON CARTRIDGE . . .
A Critique by the experts

HI-FI STEREO REVIEW The tracking was excellent and distinctly better in this respect than any other cartridge we have tested. The frequency response of the Stanton 681EE was the flattest of the cartridges tested, within ±1dB over most of the audio range.

AUDIO The 681's low-mass stylus assembly is probably responsible for the cartridge's superb tracking performance at such low forces as 1 gram. We found that the Stanton 681EE tracked some previously "unplayable" records . . . 681EE is not at all susceptible to hum pickup . . . The 681EE stands among the top few cartridges on the market.

STEREO & HI-FI TIMES "I have subjected the cartridge to a series of standard test records which I use for all cartridges I test. In all cases this Stanton is as good as any I have yet checked, better in some cases than all others, no worse in any case than any other. Stanton calls this cartridge a "calibration standard". My tests confirm these figures."

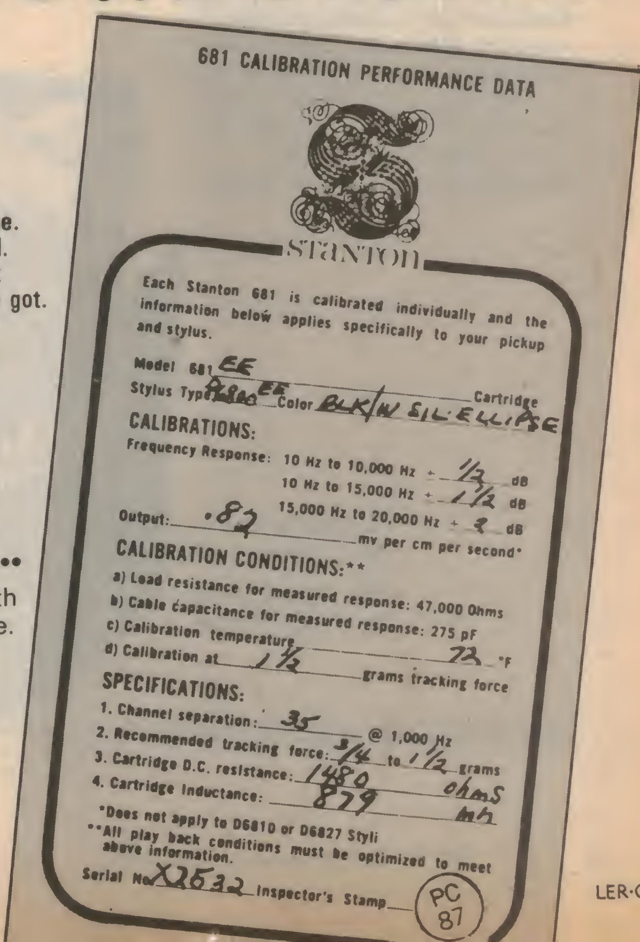
HIGH FIDELITY The cartridge's vertical angle was exactly 15 degrees—the first, incidentally, that CBS labs has ever measured that was exactly 15 degrees! This is a cartridge that can reveal acoustic differences among recordings, that accommodates itself to the musical demands of the recorded material, and that can track the most demanding of groove passages like a champion. We mark it, in fact, as one of the very best yet auditioned.

but YOUR Cartridge didn't get a good review!

Perhaps one like it did. Same make same model, but not the one in your turntable.
Pickup cartridges are notoriously variable in quality. Take a dozen Brand A Model X and you can get a dozen different sounds.
That's why the Pro's use Stanton 681EE, the **Calibration standard Cartridge**. **Every** 681EE, not just one in ten, or one per hundred, is individually measured. if its not up to specification (and what a specification!) it is rejected. It's not sold to you on the strength of a review that a hand-picked special might have got. Rigid quality control is expensive. That's why the Stanton 681EE sells for $72.00. Expensive. Not a rip-off price, but expensive. Still you'll get more improvement for $72.00 by changing to Stanton 681EE than any other $72.00 you could spend on your gear.
So you know that the Stanton Cartridge you buy for your turntable is exactly the same in all significant parameters as the one that got rave reviews from "High Fidelity", "Audio", "Hi-Fi/Stereo Review", and other top authorities.

the proof of Stanton Superiority...

This unque calibration performance chart is supplied with every Stanton 681EE cartridge.



681 CALIBRATION PERFORMANCE DATA

STANTON

Each Stanton 681 is calibrated individually and the information below applies specifically to your pickup and stylus.

Model 681 EE
Stylus Type D6800 EE Color BLK/W SIL-ELLIPSE Cartridge

CALIBRATIONS:
Frequency Response: 10 Hz to 10,000 Hz ± 1/2 dB
10 Hz to 15,000 Hz ± 1 1/2 dB
15,000 Hz to 20,000 Hz ± 3 dB
Output: .87 mv per cm per second*

CALIBRATION CONDITIONS:**
a) Lead resistance for measured response: 47,000 Ohms
b) Cable capacitance for measured response: 275 pF
c) Calibration temperature 72 °F
d) Calibration at 1 1/2 grams tracking force

SPECIFICATIONS:
1. Channel separation: 35 @ 1,000 Hz
2. Recommended tracking force: 3/4 to 1 1/2 grams
3. Cartridge D.C. resistance: 1480 ohms
4. Cartridge inductance: 879 mh

*Does not apply to D6810 or D6827 Styli
**All play back conditions must be optimized to meet above information.

Serial No. X2532 Inspector's Stamp PC 87

Sole Australian Distributors

Leroya Industries PTY. LTD.
266 Hay St., Subiaco, Western Australia 6008.

VIC: BJD Electronics P/L., 202 Pelham St., Carlton, Vic. 3053
QLD.: Brisbane Agencies, 72 Wickham St., Fortitude Valley 4006
N.S.W.: W. C. Wedderspoon P/L., 3 Ford St., Greenacre 2190
S.A.: Sound Spectrum, 33 Regents Arcade, Adelaide 5000

LER-055.

elements horizontal.

There are areas, however, where the transmitted signal is vertically polarised, as evidenced by the fact that receiving antennas in these regions are mounted with the elements in the vertical plane.

An FM broadcast service may be based on either horizontal or the vertical polarisation and, in fact, there was strong early support for the former. However, vertical rod antennas are far the more practical for portable and car receivers and this has strengthened the case for vertical polarisation. In fact, faced with the conflict of an established domestic market and an emerging mobile audience, some overseas stations now use a more complex antenna radiating signals for both types of receiving antenna.

Assuming vertical polarisation, a vertical rod antenna is adequate for FM reception in favourable receiving locations. For a fixed domestic installation, an ordinary television antenna could conceivably be used — with two reservations: it may need to be mounted with the elements vertical rather than horizontal, and the conventional 300-ohm balanced output may or may not suit the particular tuner.

Because FM signals are concentrated within a band much narrower than the full TV spectrum, and because the lowest frequency likely to be involved is 88MHz, there is the opportunity to design special FM antennas combining compactness with good performance characteristics. This can be an important factor for listeners in difficult or fringe areas, where an efficient antenna can represent the difference between a poor signal and an acceptable one, or the ability to utilise the stereo component.

As with television transmissions, a VHF FM signal can travel between transmitter and receiver by a variety of paths. Fortunately, a sound signal does not suffer from multipath reception to the same extent as a visual image and the directivity of the antenna system is not so critical in this respect. However, it may still be important in difficult areas where it is desired to receive a relatively weak FM signal, while protecting the receiver from strong local interference or a nearby transmitter of one kind or another.

The foregoing discussion has all had to do with the "RF" characteristics of the FM signal but there is one matter to do with the "audio" characteristic that should be mentioned.

With the idea of improving further the signal / noise ratio, it has become standard practice to boost (or pre-emphasise) the treble at the transmitter during modulation, and to cut it (or de-emphasise) in the receiver by an equivalent amount. The process leaves the signal with a flat frequency response but attenuates any spurious noise entering the receiver or generated by its low-level circuits. It is basically the same idea as employed in microgroove recordings where the treble response is boosted and cut by about 10dB.

Original American practice was to boost and cut with circuitry exhibiting a time constant of 75uS. In more familiar terms, this is equivalent to a boost of about 7.5dB at 5kHz and 15dB at 10kHz.

The preference in Europe has been for a more modest figure: 50uS, representing 5dB at 5kHz and 10dB at 10kHz.

This figure is now tending to gain favour worldwide, partly because modern music and recordings contain considerable high frequency energy, and too much boost can be an embarrassment at the transmitting end.

In practical terms, the degree of de-emphasis provided in any given tuner or receiver is not highly critical, the difference between the two curves being aurally marginal. But, in any case, most modern high fidelity equipment has facilities for boosting and cutting the treble over the same frequency range and a small adjustment would suffice to offset any discrepancy.

MODULATION INDEX

The term modulation index is often encountered in FM literature. It refers to the ratio between amount of carrier swing (in a sense, the modulation depth) and the modulating frequency. For example, with a transmitter fully modulated to a 75kHz swing by 15kHz, the modulation index would be 5; this would also represent the maximum bandwidth condition, as shown on page 20. With full modulation by 1.5kHz, the modulation index would rise to 50 (75 / 1.5) but the bandwidth would recede well inside the 200kHz limit.

LOUDNESS CONTROLS . . . UGH!

by LEO SIMPSON

One of the less understood controls on stereo amplifiers has to do with the "Loudness" facility. It is usually arranged to provide about 10dB of boost at 100Hz and, on more pretentious amplifiers, about 6dB boost around 10kHz; midrange frequencies are held at reference.

Loudness controls are designed on two premises: The first is that, at low levels of sound, the sensitivity of the ear is reduced at low and high frequencies. This is well documented and we have to thank Fletcher and Munson who produced a definitive paper on the subject in 1933 along with a graph of "equal loudness contours".

The loudness control characteristic on hi-fi amplifiers is usually based on the F&M curve for a sound level of about 30 phons and is supposed to compensate for the losses of the ear at this listening level.

The other premise is that, in the normal home situation, listeners are often forced to keep the volume down out of consideration for other members of the household. In this situation, the reproduction is supposedly lacking in bass and extreme treble in comparison with the original performance. The assumption is that listeners would like to have the balance restored by applying bass and a little treble boost. This is what loudness compensation is all about.

In most amplifiers with a loudness facility, the bass is boosted by the stated amount only when the volume control is near its minimum setting. By the time the volume control reaches half-on, the boost is no longer operative.

But the logic begins to fail here because, with typical cartridges and records, most amplifiers (with volume control half-on) are already delivering maximum power on music peaks. The volume control is made to function like this because it gives the user the impression that he has a powerful system!

So we have the paradox of an amplifier that is quite loud at even quarter setting; yet the loudness facility is applying bass and maybe treble boost to compensate for hearing losses which are only apparent at much lower sound levels.

The designer of an amplifier incorporating loudness compensation is thus caught between two stipulations: "Make sure it's loud at the half setting, otherwise people will think it's gutless" and "taper off the loudness boost according to the Fletcher and Munson curves".

But that's really a joke because, at any given setting of the volume control, the designer cannot predict how loud the system will be. Even if he knew the loudspeakers it would be used with, the different signal sources such as discs, tapes and radio tuners vary unpredictably in the signal they feed to the volume control.

Really, the only method by which an audio system could be precisely compensated to suit the hearing characteristic of a given listener would be to have a dynamic feedback system whereby the overall sound level was monitored and bass and treble boosted appropriately. The compensation would vary from moment to moment according to the dynamic range of the program.

You would need a computer, working in real time and programmed with the full hearing characteristic of the listener. But even so the computer would be nonplussed if it had to provide loudness compensation to suit two or more listeners at the one time. Each listener has a different hearing loss characteristic, varying markedly from the average curves produced by Fletcher and Munson.

When you think about it, there is a lot to be said for a simple unadorned volume control.

Really, the loudness facility functions mainly as a preset bass boost control. But, as such, it tends to apply a fair amount of boost at the upper bass frequencies around 400Hz and this tends to "muddy up" the music. And if that's not bad enough, many users apply boost with the tone controls too!

This can add up to an unrealistic bass reproduction which, besides being a definite departure from realism, can also run the amplifier and perhaps the loudspeakers close to overload at modest listening levels.

Why spend a lot of money on a high performance audio system and then spoil it all by using the Loudness facility. As far as I am concerned, the best feature of the Loudness facility on an amplifier is the switch to turn it off.

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EM interference — SAA publishes new standards

Electromagnetic interference to broadcast stations by electrical equipment is a serious problem. The Standards Association of Australia has studied this problem quite extensively, and is currently preparing and publishing a series of standards which will help in its control. This article considers some aspects of the work done by the SAA on electromagnetic interference.

by RON PROFITT*

One of the most vexing problems facing the broadcasting industry of the future is the problem of controlling radio interference. In the past, radio interference usually meant interference to broadcast transmissions by other users of electrically-operated equipment, which generated, either directly or indirectly, radio-frequency energy of the same wavelength as that being broadcast. This has resulted in the use of the radio spectrum in a very wasteful manner and has caused many headaches for the authorities charged with the allocation of radio services and the prevention of radio-frequency pollution.

It is now recognised, however, that the problem is open-ended, and that other services and facilities can also meet with interference from radio and television broadcasting. Planning authorities are now placing heavy emphasis on the most efficient use of the radio spectrum, on the basis of the costs involved in using higher frequencies, in order to avoid the present congestion at VHF and lower frequencies.

This, then, is the background to the work currently being undertaken by the Standards Association of Australia (SAA) through its committee on electromagnetic interference. For some years, this committee has been studying the various problems being experienced due to electromagnetic interference, and has been working on a series of standards which will help in its control. The series includes standards on methods of measurements for radiated and conducted interference, measuring equipment and limits of interference emitted from various types of radio and electrical equipment. Some of these standards have recently been published, these being:

- AS1054—1973, Electromagnetic Interference Limits and Measurements for Semiconductor Control Devices;
- AS 1053 — 1973, Radio Interference Limits and Measurements for Television and Radio Receivers;
- AS1044—1973, Limits of Electromagnetic Interference for Electrical Appliances and Equipment.

Two further standards on methods of measurement and measuring equipment for use over the frequency ranges 10kHz — 150kHz and 150kHz — 1,000MHz are approaching the final stages of publication. In addition, the SAA has published a draft standard entitled "Limits of Electromagnetic Interference Generated by Industrial, Scientific and Medical Radio-Frequency Equipment." Another draft publication entitled "Electromagnetic Interference from High Voltage Transmission Lines" is currently under preparation. Further work will include standards on the limits of interference from the ignition systems of internal combustion engines, and from fluorescent lighting.

Standard regulations set by the SAA are not mandatory, and their adoption and use is, in general, purely voluntary. It is only in the case of special government legislation that SAA provisions become enforceable by law. It is considered by the Association's expert committee, and by various authorities and interested bodies, that if the problem of radio interference is to be controlled, legislation to enforce these standards will be required.

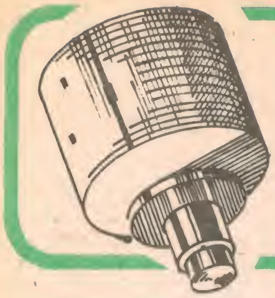
A 1970-71 report prepared by the Institution of Radio and Electronics Engineers (IREE) stated that all those in Australia who use radio equipment for the purpose of communication are strictly controlled. All operators are licensed, and they are granted licences only if their equipment will not interfere with other users. By contrast, existing legislation makes almost no provision for controlling interference from equipment which generates radio-frequency energy, either intentionally or unintentionally, for purposes other than for communication.

Clearly both types of user of the radio-frequency spectrum have rights. Excessively severe legislation would be both unfair and uneconomical. The Standards Association is firmly convinced, however, that regulations should be adopted to permit the appropirate statutory authority to enforce compliance of those limits of interference proposed by The International Special Committee on Radio Interference (CISPR) which have been adopted in the relevant Australian standards.

The SAA committee on electromagnetic interference includes representatives from the Postmaster-General's Department, Department of Supply, Department of the Navy, Defence Standardisation Committee, CSIRO Division of Applied Physics, Australian Broadcasting Commission, Australian Broadcasting Control Board, Overseas Telecommunications Commission (Australia), The Institution of Radio and Electronics Engineers Australia, The Institution of Engineers Australia, Federation of Australian Commercial Television Stations, Federation of Australian Commercial Broadcasters, Associated Chambers of Manufacturers Australia, and the Plastics Industry Standards Committee.

*Secretary of the SAA Telecommunications and Electronics Standards Committees.

Radio frequency industrial equipment can cause severe interference, as illustrated by the photograph at left.



News Highlights

Portable radar locates buried objects

A portable radar system, ·capable of "looking down" dhrough concrete and several feet of soil, has been developed by the Calspan Corporation of Buffalo, New York, in assiciation with the Mine Detection Division of the US Army Mobility Equipment Research & Development Centre at Fort Belvoir, Virginia. The new system has a number of varied uses from detecting buried objects to monitoring the subsurface conditions of highways.

Anthony V. Alongi, staff scientist from Calspan's Electronics Department, said the system can be used to locate and signal the presence of such buried objects as plastic mines, human bodies, and underground conduits.

"The nature of the radar return distinguishes these substances from each other and from such natural subsurface formations as rocks and boulders," Mr Alongi said. Detection is made possible ty the fact that every subsurface discontinuity will exhibit a change in electrical properties. As the radar signal penetrates the soil, part of its energy is reflected back to the antenna. The characteristics of the returned signal relate to the nature of the surface that reflected it.

An Army announcement said the experimental equipment supplied by Calspan "has demonstrated excellent potential in field tests." The Army has wanted such equipment since the development of plastic mines — which contain no metal and, therefore, cannot be spotted by conventional mine detectors. Plastic mines, which are inexpensive to manufacture, caused many US casualties in South Vietnem.

"Calspan is currently utilising the equipment it developed with the Army to investigate the feasibility of applying this radar technique to a number of very importatn civilian functions. One major use of the new rader system will be to map the location and depth of underground conduits, sewers and water lines down to 2 inches in diameter. Concrete is, in effect, transparent to radar, thus enabling plastic pipes to be traced through concrete walls. Another possible use for the new system is monitoring the subsurface condition of concrete highways."

Mr Alongi said a version of the radar with multiple antenna horns, carried on a vehicle, could easily be built to monitor the subsurface condition of major highways: "Cruising at 60 mph, it could be used to guide routine maintenance, or survey entire highway systems for hidden weakened spots in areas where major flooding has occurred," he stated.

Calspan has also developed, in association with the US Army, a one man version of the radar system which weighs

less than 20 pounds. Straps over the operator's shoulders support a 10 foot long horizontal boom. The antenna horn is mounted vertically at the end of the front half of the boom, whilst the batteries and transmitter are in a balancing box at the back end of the boom. The equipment can be set either to produce a video signal on the screen of a small oscilloscope strapped to the operator's chest, or an audio signal through a pair of headphones.

"Although military versions are intended primarily for objects buried no more than a foot or two, we can make trade-offs in the present design, for example in resolution, which will permit penetration to many feet for civilian projects," Mr Alongi said. Among these may be the location of bidies buried in soil, a severe problem in law enforcement for which no satisfactory technology has existed.

—George E. Toles.

Solid waste could light US cities

An official of the US Environmental Protection Agency (EPA) said recently that there is enough energy in the solid wastes of large US cities to light every home and commercial establishment in the country all year long.

Arsen Darnay, EPA's Deputy Assistant Administrator for Solid Waste Management Programs, told a news conference that the wastes could be converted into energy to generate electricity in large urban areas. The total energy saving provided by big city waste, he said, would be the equivalent of 150 million barrels of oil a year.

If the burning is accompanied by recovery of the metals, glass, rubber and other items for recycling, he said, there would be an additional energy saving equal to 30 million barrels of oil a year. The reason for this is that it normally takes less energy to manufacture a product using secondary materials, such as scrap iron or steel, than to make it with the virgin materials counterpart, such as iron ore.

Darnay listed 21 cities, including such large urban areas as New York, Chicago, Philadelphia and Detroit, where a plan to burn trash as an auxiliary fuel to make electricity has either been adopted, or is under serious consideration.

Local diode maker expands production

In view of the recent closures and winding-down of local semiconductor manufacturing plants, it is heartening to hear that one plant at least is actually expanding operations: Centre Industries, the Sydney-based facility operated by the Spastic Centre of NSW. The plant has been making General Electric A-14 glass passivated silicon diodes since mid-1972, as we reported on page 15 of our June, 1972 issue.

Now CI and Australian General Electric have announced that the plant has been expanded, and is producing the more husky A-15 diode series as well. The new devices are basically a scaled-up version of the A-14 series, and offer 3-5 amp capability as well as the transient protection feature offered by the smaller devices.

The move to expand production at the plant testifies to the success achieved by CI in adapting to modern solid-state production technology. In the two years since the plant started production many tens of millions of devices have been shipped, and reliability has been outstanding according to AGE's National Manager for electronics, Bryan Catt.

"We at AGE welcome the expansion of CI production to cover both device families," said Bryan, "and we look forward to as great an acceptance of the A15 product as has been achieved over the past two years by the A14 series. We are very impressed by the professionalism which Centre Industries has shown in producing these devices."

Total production of A14 devices for 1974 is likely to be well in excess of 20 million, of which more than 16 million will be exported to the US and Canada. Initial production for the A15 devices is projected at more than 1 million per year.

Acceptance of the devices locally has been high. At least one local TV set manufacturer is using A14 diodes exclusively in both monochrome and colour sets.

Super-cooled motors may power US ships

The development of an electrical propulsion system using superconducting generators and motors chilled close to absolute zero promises significant fuel savings for ships like hydrofoils, destroyers, and other large surface ships. One such system is currently being developed by the General Electric Research and Development Center under a three-year contract from the US Naval Ship Systems Command, Washington, DC.

Superconducting machinery takes advantage of the fact that certain metals and alloys offer zero electrical resistance and demonstrate unique magnetic properties at temperatures close to absolute zero (minus 273 deg C). For shipboard applications, such machinery promises improved fuel consumption, reduced size and weight of propulsion systems, and greater flexibility for locating engines within a vessel.

The three phase $US3.9 million project calls for the evaluation, design, and manufacture of a superconducting, direct-current drive system capable of producing 4,477kW (6,000 horsepower). Evaluation trials are to be carried out by the US Navy.

High performance colour TV camera

Australian Video Engineering have recently released onto the Australian Market a new inexpensive, high performance colour television camera for use in studio, outside broadcasting, and CCTV applications.

Manufactured by Ikegami Tsushinki in Japan and designated the CTC-3X, the new camera is lightweight, has high sensitivity, is easy to operate, and can be purchased with a range of accessories, including a choice of pick-up tubes and lenses. The basic operational controls of the CTC-3X are the same as for a black and white camera, these being the power on/off switch, the zoom control, and the contrast and brightness controls.

Optional equipment includes a separate camera control unit, a 6 channel colour mixer, an external sync generator, an external PAL encoder, and a subcarrier phase control unit.

Sunlight could propel future spacecraft

A standardised Solar Electric Propulsion Stage (SEPS) that could become an important part of a space transportation system for a wide range of payloads for planetary and Earth-orbital missions is currently undergoing research at NASA.

SEPS is one of several concepts under consideration for the application of solar electric propulsion. Another approach is to employ SEP as an integrated spacecraft propulsion subsystem. Alternatively, an attachable SEP module could be developed that would have growth capability to a stage, but could provide solar electric propulsion for planetary spacecraft until the full SEP stage is developed.

Essentially, the SEPS consists of a modular electric propulsion subsystem and a common structure which houses its operating subsystems. It will be capable of accepting modules such as a docking subsystem for Earth-orbital missions, or a science package for planetary missions. In addition to the attachable SEP module concept, which provides propulsion only and depends on spacecraft subsystems for all other functions, the SEPS could provide such functions as telemetry, attitude control, data handling, etc.

The SEPS will utilise high power solar arrays and electric thrusters, and will be designed to be compatible with the Space Shuttle and Space Tug. Current studies assume a slow flyby of Comet Encke in 1979 as the first SEPS mission.

The 1979 Encke slow flyby mission has two objectives. It will evaluate the performance of solar electric propulsion and provide engineering data in support of future flights, and will perform a preliminary scientific investigation of the Comet Encke.

Dick Smith opens new electronics centre

Dick Smith Electronics Pty Ltd has opened a new store at 361 Hume Highway, Bankstown, approximately 100 metres from Chapel Road. The new store began trading in June, and is the only one in the area catering for the needs of hobbyists and professionals. All mail orders will continue to be handled at the Dick Smith Electronics Centre at Gore Hill.

To celebrate the opening, Dick was giving a free introductory pack to all customers who called at the new centre during June. Included in the pack was a miniature LED, a signal diode, and an audio transistor.

New range of video equipment from Sanyo

Sanyo have recently introduced a new range of video equipment on the Australian market. Included in this new range is equipment claimed to be the world's smallest portable video cassette recorder (pictured at right).

Mr Matulick, Australian Sales Manager for Sanyo, said that "the initial display of Sanyo video and closed circuit TV systems will comprise the most comprehensive line-up yet offered in this country." According to Mr Matulick, Sanyo's introduction of their video systems is just the first of several unveilings planned for this year. Still to come are public address systems, transceivers, microwave ovens, and specialised components and instrumentation.

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Model	Nominal Cone Diameter	Ceramic Mgt. Wt. (Ounces)	Voice Coil Dia.	Application	Free Air Resonance (Hertz)	Response Range (Hertz)	Nominal Sensitivity Level (Decibels)	Power Rating Maximum Continuous Watts	Max Depth
10E18L	10"	18.0	1½"	Lead Guitar-Organ	80-100	80-7000	97	60	4¾"
10E18B	10"	18.0	1½"	Bass Guitar	50-70	50-4500	97	60	4¾"
10G54L	10"	54.0	2"	Lead Guitar-Organ	60-80	60-7000	100	100	4⅞"
10G54B	10"	54.0	2"	Bass Guitar	40-60	40-4000	100	100	4⅞"
12C10L	12"	10.0	1"	Lead Guitar-Organ	75-95	70-7000	100	25	6"
12E18L	12"	18.0	1½"	Lead Guitar-Organ	80-100	80-7000	100	60	6½"
12E18B	12"	18.0	1½"	Bass Guitar	45-65	50-4000	98	60	6½"
12G54L	12"	54.0	2"	Lead Guitar-Organ	70-90	70-7000	102	100	6"
12G54B	12"	54.0	2"	Bass Guitar	30-50	30-4000	100	100	6"
15E28L	15"	28.0	1½"	Lead Guitar-Organ	70-90	70-8000	102	60	7⅝"
15E28B	15"	28.0	1½"	Bass Guitar	35-55	30-4000	98	60	7⅝"
15G54L	15"	54.0	2"	Lead Guitar-Organ	70-90	80-8000	107	100	6¾"
15G54B	15"	54.0	2"	Bass Guitar	30-50	30-4000	100	100	6¾"
18G54B	18"	54.0	2"	Bass Guitar	30-50	20-3000	100	100	7⅞"
18K96B	18"	96.0	3"	Bass Guitar	35-45	20-3500	103	125	8"

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SYDNEY 2000

NEWS HIGHLIGHTS

Briefcase of the future here now

A glimpse of things to come has been provided by electronic designers at Honeywell and Samsonite Luggage with a one-of-a-kind model briefcase designed to meet the everyday needs of a business executive in the year 2000. This versatile case is actually a portable electronic communications and computing centre.

But it could become fact rather than fiction, even before 2000. Honeywell scientists say there is nothing "outlandish" about its contents — that a working model of the briefcase would be feasible in 3 to 5 years, while normal commercial production is possible within 10 to 15 years.

Built into this 5-inch-wide brief case is every conceivable type of electronic equipment designed for instant communications, including a TV screen, light pencil, micro-optical information storage file, remote television camera and tripod, keyboard and telephone.

First to catch the eye is the TV screen, and immediately beneath it is the light pencil. The telephone can be automatically connected to any number in the computer memory file. Calls could be made either "in the clear" or "scrambled" to private phones with appropriate descramblers.

Stored in the bottom half of the case are the remote television camera and tripod, and next to that are the typewriter and pushbutton keyboard for communication with the storage file and/or various computers.

In typical operation, a sales executive would activate his battery-powered case, and then connect it through available contacts to his customer's computer. This, in turn, would be connected by data link to the salesman's home office computer. Thus, working in the field, the men would have all the benefits of the powerful central computers of each company to instantly work out specifications, production and delivery schedules and financial arrangements.

All pertinent information, such as prices and schedules, would be displayed on the TV screen. Changes, revisions or notes could be entered directly on the screen (and into the computers) by using the light pencil or activating the keyboard.

If an engineer or other expert were needed, he could be called on the telephone and referred to a similar screen at his remote location. The TV camera could be used to show a piece of equipment or even an entire area that required examination before decisions could be made.

For the harried executive who fears that this computer-crammed case leaves no room for storing his lunch, there's also a space next to the TV screen, with ample room for futuristic lunch pills, small personal effects, business cards, aspirins and snapshots.

Humidity sensitive switch from Matsushita

The Wireless Research Laboratories of Matsushita Electric, Tokyo, Japan, have announced the development of a new humidity sensitive switching element, the first of its kind to be developed in the world.

The basic structure and operating principles of Matsushita's new humidity switch are as follows: electrically conductive grains are mixed in a special polymer compound which is coated upon an insulating substrate such as glass or plastic film. When the polymer compound absorbs humidity, contact resistance between the conductive grains increases sharply, resulting in a steep increase in the overall resistance of the device. By selecting suitable combinations of the conductive grains and the polymer compound, various types of elements can be made to function at any given humidity level between 50pc and 100pc.

Conventional humidity sensitive substances used in the past include human hair, nylon film, and other hygroscopic materials. However, the application of these devices is limited to meteorological observations and to industrial fields due to their slow reaction to humidity changes. In contrast to this, the the new device has a fast response time; and it may be powered by either AC or DC, is low in cost, and features high reliability.

Potential applications for the new device include: humidity control in refrigeration equipment, greenhouses, and air-conditioning equipment; defogging of automobile window glass; meteorological observations; and the monitoring of humidity levels in electronic equipment and precision instruments.

—L. Williamsen.

Dutch initiate trial videophone network

A trial network providing a videophone service to 65 subscribers has been set up in the Netherlands by the Philips organisation, with the co-operation of the Dutch Post Office. Current plans call for the trial operation to be carried out over a period of two years to enable equipment performance studies to be carried out.

The trials stem from the concern felt in the Dutch Government and industry circles about the severe load placed on resources and the environment by the immense amount of business travel undertaken in all levels of industry. They believe that, with the very rapid growth in electronics expertise, the time is not far away when face to face communication between business people will be achieved satisfactorily without either having to leave the office.

Operation of the network, which stretches some 400km has already been demonstrated. It is a dial up system working through ordinary telephone lines. The trials are being carried out on 325 line and 1MHz rather than the 625 lines (5MHz) of the Dutch television system.

Big, cheap CATV system for Ohio

Although experimental installations have proved that two-way cable TV is technically feasible, the large scale development of such systems has been hampered by the high cost of workable home terminals. But now Coaxial Communications Incorporated of Sarsota, Florida, which has the franchise to install CATV lines to some 60,000 homes in Columbus, Ohio, is planning to wire the first 10,000 to 15,000 subscriber sets on a completely bi-directional hookup, using only slightly modified standard CATV converters.

These new modified converters will be approximately one quarter the cost of home terminal units presently designed for two-way cable. The cost savings result from Coaxial Communications' system which groups 100 to 200 homes on a time-and-frequency-division-multiplexed network. In previous bi-directional designs, each home terminal required a signal-processing module and transmitter.

A minicomputer at the operator's central station (head end) polls terminal amplifiers controlling groups of homes, rather than individual TV receivers. This arrangement also makes it possible to "open" only a small percentage of the lines at any one time, thereby limiting the amount of interference that can penetrate the net. In the present set-up, a modified General Automation minicomputer polls the group terminal amplifiers every three to five minutes. It records the channel being watched and, if it is a pay TV channel, bills the subscriber \$1.50 to \$2.50 per movie.

The set-top converters — Oak Industries Incorporated's Gamut-26 units — are ordered with modest additions: a digital encoder chip, which encodes the channel position of the tuner shaft, and an extra power supply. To this, Coaxial Communications adds an assembly of four ICs and about 20 discrete components. The total cost of the home unit is about \$60.

Innocent join guilty in computer crime files

Faced with an increasingly mobile criminal element, both the United States and Britain are centralising arrest records in national computer data banks. In the US, this has resulted in computerised crime dossiers on more than half a million citizens. But what about the rights of the individual in an intensely impersonal system where privacy safeguards are virtually non-existent? This article highlights some of the problems of computerised crime dossier systems in the United States.

by E. DRAKE LUNDELL* and MARGUERITE ZIENTARA.**

It was a minor charge — a traffic violation. David Harkness was ready to pay his $15 fine and walk out the door when an officer came back to his cell in the Des Moines, Iowa, police station and announced, "Bud, you're not going anywhere — the Marines got a hold on you."

A detective then showed Harkness a copy of the FBI National Crime Information Center's (NCIC) computer printout listing Harkness as being AWOL from the Marines since January 1972 and a deserter.

In reality, Harkness was not AWOL, was not a deserter and was not even a Marine. But Harkness was not that surprised on 28 May, 1973, since it had all happened before, on 26 June, 1972, also in Des Moines, when Harkness had first been arrested for being AWOL. His discharge papers show he left the service on 3 May, 1972.

The trouble stemmed from a time when Harkness was indeed disciplined for being AWOL from the Marines. The FBI's crime computer did not, however, finish the story it began. A record of Harkness' discipline for his crime was never put into the file, resulting in a "hit" every time for the NCIC crime computer.

In the Harkness case, the real problem was the lack of an enforceable federal requirement that the FBI be notified when a wanted person has been arrested or when the charge against him has been dismissed.

The Harkness story is one of many about the innocent or absolved who cannot get out of the FBI's crime data bank. The administrative weaknesses that lead to David Harkness' difficulty were previously dismissed as unimportant. But the FBI is now rapidly expanding its computer systems to add far more sensitive information, and civil libertarians have become alarmed. The publication last month by the FBI of long awaited privacy safeguards has only strengthened the privacy-advocates' resolve, as the new safeguards turned out to be identical to the old ones and depend upon the honesty of local policemen.

In the US, police records are traditionally kept on the local or state level rather than on the regional level as in Britain — many states, for example, developed their own independent teletype networks to notify local police departments about wanted or missing persons.

But to aid capturing interstate criminals, the Federal Bureau of Investigation (FBI) set up the National Crime Information Centre (NCIC), which permits a policeman anywhere in the US to find out within seconds if a person is wanted by the police somewhere else.

The FBI has a central computer in Washington, and more than 7000 teletype terminals are located throughout the country, primarily in local police stations. But their connection is complex; only a few teletypes are connected direct to the FBI computer. In most states, the state police have their own computer which is linked to the FBI computer. The local police teletypes are then connected to the state computer, which acts as a "telephone exchange" routing inquiries to the FBI computer, as well as storing some information itself. Each state has its own set of rules governing access to its computer, and thus to the FBI computer.

Originally, the computer had a file of wanted persons and six kinds of stolen articles: vehicles, licence plates, securities, boats, guns and miscellaneous items. A typical emergency use would be for a Michigan patrol car following a suspicious car with Florida licence plates to radio headquarters, asking for a check on the licence number to see if the car was stolen.

*Computerworld Chief, Washington Bureau.
**Computerworld Staff Writer.

At left, the IBM police computer in Chicago. Crime reports from the computer, such as the one being checked below by two Chicago police officers, help free policemen from routine paperwork.

If the car had been used in a crime, or the occupants were known to be armed, this information would be automatically provided as well.

The system is used heavily. During July 1973 the central computer handled approximately 109,000 transactions per day, including inquiries, updates, and entries. And there was an average of 800 "hits" a day, in which the system gave a positive response to a police inquiry. The system necessarily has to be quick and easy to use, and there is little worry about invasion of privacy — anyone wanted for a crime has more serious problems than privacy.

The FBI, however, is really running a "left luggage" office for criminal data. In keeping with the US tradition of decentralisation, all data entry is done by local or state police (except for federal crimes). If a car is stolen in Lansing, Michigan, and recovered in Miami, Florida, it is up to the Lansing police to add the listing to the file and the Miami police to remove it.

Unfortunately, the police are better at starting a file than updating. There have been cases of the rightful owner of a car being arrested for stealing his own car — because it was once listed as stolen and the file was never purged from the computer when it was recovered. The same applies to people, as David Harkness can testify.

This was not considered to be too serious a problem until it was decided to set up a national data bank of criminal histories. Commonly called a "rap sheet" in the US, the computerised criminal history (CCH) is supposedly a listing of contacts the criminal has had with the law. In addition to fingerprints and description, it includes dates of arrests, charges, court appearances, disposition of the case (guilty, innocent, or charge dropped), sentence, prison record, probation, etc. Rap sheets are used by judges to set bail and determine sentence, by prison and parole officials, and by police and government investigators. There is widespread agreement that a national rap sheet file is needed because of the increasing mobility of US criminals.

Fingerprint files are also going computerised in the United States. This automatic fingerprint reader, designated "FINDER", is capable of processing more than 500,000 resolution elements of a fingerprint in one-half second. Developed by the Calspan Corporation of Buffalo, New York, the system is currently in use with the FBI.

But there is also widespread concern because these files would be far more sensitive than traditional NCIC files. They would contain not only the names of wanted persons, but of almost anyone ever arrested — whether or not they were convicted or even ever brought to trial. And many states also maintain "intelligence information" in their own computers — usually about the Mafia and political dissidents — and this data would also be available through the FBI computer. And there is some evidence of abuse of such records on the state and local level, as is typified by three incidents:

- A Massachusetts Grand Jury is now investigating allegations that people in the state police headquarters regularly sold rap sheets to private detective agencies who passed them on to large department stores wishing to check on prospective employees.
- In Fort Worth, Texas, a local supermarket obtained (from the Fort Worth Police) and posted a rap sheet, supposedly of union organiser Charles Tosh, in an attempt to discourage employees from voting for union recognition. Unfortunately, the rap sheet was of convicted felon Charles Tosch, who was of no relation to the union organiser.
- In New York. stock brokerage houses have legal access to rap sheets. This law was passed because of fear of organised crime infiltration into the stock market, and it has no rules as to how the data is to be used. Several people have been fired, even though they were acquitted of all charges against them, because the arrests showed that they were associating with the "wrong sort of people."

It was widely felt that the very basis of the NCIC system made it unsuitable for CCH: NCIC is designed for rapid unquestioning response, while CCH data should be protected by rigid rules and is not needed so quickly. CCH grew out of the Justice Department funded Project Search, which began work in 1969. The Search people argued that CCH files would need much greater protection than was afforded NCIC files, and would have to be more closely guarded, and thus should be separate from NCIC.

With the plum of a national computerised criminal history system up for grabs, however, the FBI was hardly willing to let it be developed outside the Bureau. An intense, bitter bureaucratic struggle ensued and in December, 1970, the Attorney General, John Mitchell, awarded the system to the FBI and its then director J. Edgar Hoover. The FBI chose not to make the CCH a separate system and decided simply to add it to NCIC as an eighth file, even though it was bigger than the other seven files combined. It went into operation in November, 1971, and now contains more than half a million rap sheets. Only six states can now add data, although most can make inquiries.

At first, the FBI announced that since all FBI men and police officers were trustworthy, no additional safeguards were needed to protect the more sensitive data. Then it tried to calm fears by saying that tighter regulations were being considered, but the tighter "safeguards" published in the January Law Enforcement Bulletin are simply the old ones. The rules include the right of an individual to see his record, if he is willing to go to the local police in person (usually during working hours), be fingerprinted, and present other "appropriate identification". He then has the right to challenge information in the file, but there is no requirement that the file be changed and no recourse for the individual if the file is not changed. And the rules require that only data on "serious" offences be kept, but the word "serious" is not defined. Massachusetts Governor Francis Sargent reports the case, for example, of a man who found that his mother was in the file because when she was 18 years old neighbours complained of a noisy sorority

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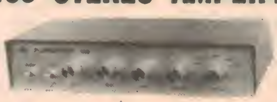

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CLASSIC RADIO

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At left, operators in the CIB's computer room, Sydney, feed crime information into the NSW Police computer. Above is Constable Paul Scott retrieving information at one of the line printers.

party, and whose step-father was in the file because he had once reported receiving a bad cheque.

There are no criminal or civil penalties for the misuse of data. The only penalty is disconnection of the terminal — a penalty rarely, if ever, used by the FBI. In any case, misuse is hard to detect; NCIC terminals are not locked and use no codewords or other security procedures. There is no way for the FBI to identify the terminal or its user. And the only log is a manual record, supposedly kept next to the terminal.

Perhaps the most serious problem is that dissemination of information is governed by state laws. That often means that if a person cannot get the information in one state, he can simply ask for the same data in a state with weaker laws — the stronger laws of the state that may have started the file do not apply.

At least two states have rebelled, passing strict privacy laws and refusing to put data into the national CCH system. Both Massachusetts and Iowa now give individuals — and their lawyers — broader rights to see and correct computer files; both also prohibit the storage of information on arrests that lead to acquittals. Massachusetts requires that once an agency has received data from the state CCH, it cannot pass the information on to anyone else. Iowa bans the computerisation of intelligence data.

Governor Sargent declared open war on the FBI's CCH. "To be frank," he declared, "recent revelations concerning the Department of Justice, the FBI, and top government employees do not inspire confidence." He said that "special precautionary steps" were needed to "protect individual rights", and he cut off federal access to much Massachusetts data.

Federal law gives banks and a wide range of state and local agencies access to the CCH, but the new Massachusetts law limits access strictly to criminal justice agencies. The government responded by threatening to hold up $30 million in Small Business Administration loans and disaster aid because the recipients could not be properly investigated, and the military held up some 2,300 security clearance investigations because it could not get into state files. Eventually the government gave up, in what Governor Sargent considered a major victory.

Sargent is still pressing for safeguards to the system and has appealed to other state governors for help. So the battle is likely to continue for some time.

In Britain, the Police National Computer is much less advanced, but it will store much the same data and will apparently have similar weak access rules. Whether or not the British benefit from the problems that have arisen in the US system remains to be seen.

Perhaps some aspects of the legislation passed recently by the Swedish Government concerning private data banks could be applied equally as well to governmental crime dossiers. Due to come into effect in July this year, the new legislation imposes severe restrictions on the private use of data banks and takes positive action to protect the rights of the individual against their misuse.

One particularly important aspect of this legislation is that individuals have the right to get a free printout, in understandable form, of any data bank entry about them. An individual will be able to demand that any errors in the entry about him be corrected, or failing this that the entry be deleted. Not only this, but the individual will be able to sue the data bank if it propagates false information about him.

While the new law will obviously not prevent the illegal use of data bank information, it does make official recognition of the potential dangers of data banks where the rights of the individual citizen are concerned, and institutes a comprehensive system of legal safeguards.

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THE SITUATION IN AUSTRALIA

In Australia, the NSW Police Department has been using a computer at CIB headquarters in Campbell St, Sydney, since 1968. The system is "on-line", providing immediate access to stored crime intelligence information 16 hours a day. In addition, there is unlimited capacity for "off-line" storage of management information for planning purposes in such areas as personnel distribution, resource utilisation, and strategic planning.

One project undertaken recently by the Research Branch was a review of procedures associated with the reporting of crime and with the processing of such reports. This project led to the development of the Crime Information and Intelligence System within the Criminal Records Office.

The computerised system involves the collection, organisation, storage and updating of information associated with crime, suspects, arrested persons and their associates. To be entered on file, a person must be arrested, fingerprinted and charged with an offence. This information remains in the computer even if the person charged is found to be innocent.

Information for the system is fed into the computer by visual terminals which are at present located at the Modus Operandi Section and operated by trained staff. Information stored in the computer can be retrieved and displayed on these same terminals within a matter of seconds. Police at Divisions or from the country can ring the Modus Operandi Section and obtain any information they may require.

For example, an officer can ask the computer what crimes have been committed within a certain location and, if desired, this can be narrowed down to a particular type of crime, or to a particular date. He can also ask the computer whether a particular person is recorded as being either a complainant or a victim, a suspect or arrested person, or whether he is listed as an associate of persons recorded. All in all, there are 20 different combinations of information to which police have access.

Access to files in the computer is strictly limited to the police departments of each State and to the Commonwealth Police. No information is supplied to private individuals or concerns, and, according to the NSW Police Force, the files are kept up to date.

As yet, there is no national crime computer in Australia, and so problems on the national scale currently experienced in the US have not yet become apparent here. Already though, there are signs of weakness in that the individual has no right to see his file, and the names of those persons acquitted of a charge are kept on file.

Australia's radio pioneers — 3

World War 1 left behind a legacy of experienced radio operators; men who were to have a profound influence on Australia's fledgling radio industry during the next decade. This article, the third of a four part series, highlights the serling work of the amateur radio movement during the 1920's and sketches the origins of our broadcasting system.

by PHILIP GEEVES*

World War I made unprecedented demands on scientists, hastening the development of the triode valve and its offspring, radio telephony. When the war ended it was clear that vacuum tubes would dominate the future of radio. Another byproduct of the war was a sizeable contingent of experienced radio men, veteran operators from the armed forces and the mercantile marine, some of whom had squeezed more adventure into a few years than most men know in a lifetime. That happy breed included the past doyen of our electronics industry, the late Sir Lionel Hooke, who after serving as wireless operator to Shackleton's 1913-4 polar expedition, donned naval uniform and saw plenty of action in the ensuing years.

*Fellow of the Royal Australian Historical Society.

The hard school of war produced a generation of operators who had a genius for improvisation and "could read Morse in their sleep, even through a welter of static;" the sort of rugged individualists who, before the war, had carried their own crystal receivers to supplement the regulation shipboard "Maggie" — Marconi's clockwork magnetic detector. Later they acquired their own valve receivers and used them wherever they went.

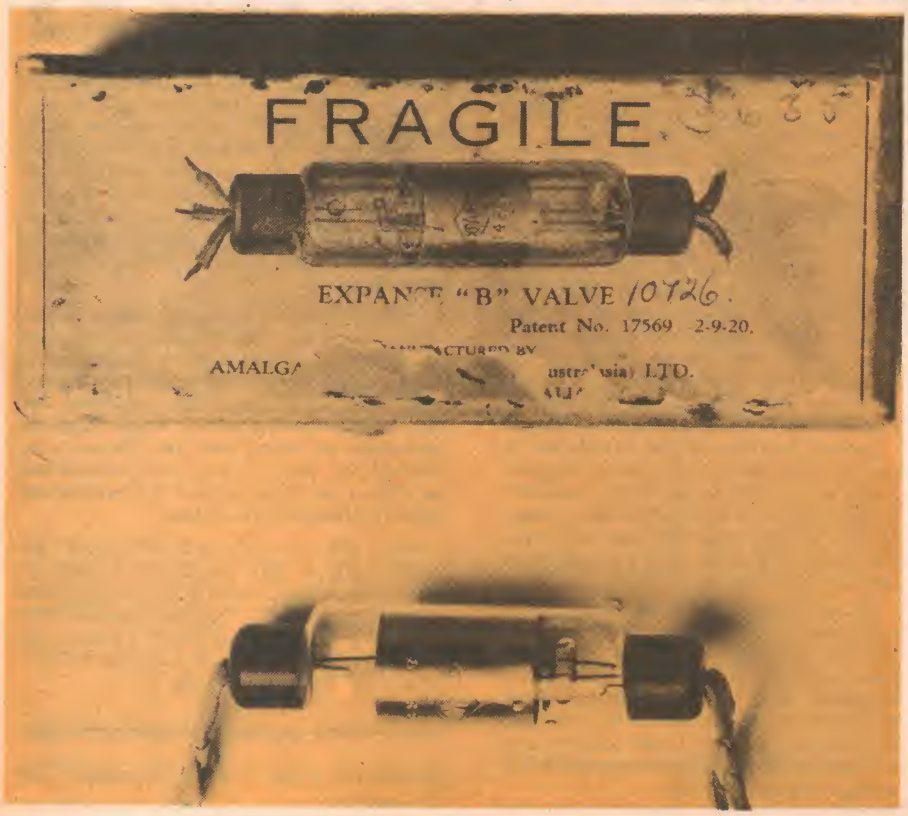
On returning to Australia for demobilisation, many operators brought with them a precious triode valve swathed in cotton wool, because men of that generation never forgot the thrill of their first exposure to radio telephony. Harry de Dassel remembers hearing a 1916 transmission of speech and music from San Francisco when he was operator aboard the "Moana" . . . "the captain swore it was the ship's engineers playing a practical joke."

Early in 1919, AWA decided to test the local potentialities of radio telephony. First it was necessary to build a transmitter, a task assigned to William Bostock, a decorated war veteran who subsequently rejoined the RAAF and became an Air Vice Marshal. Bostock's little transmitter used a single Marconi Q valve. One of the project engineers, Eric Burbury, recalls . . . "the normal anode voltage was about 40, but we gave it 240 volts and hooked it up into an oscillatory circuit. The anode glowed a bright cherry red and the valve radiated quite a bit of power." When tested in coastal vessels, this transmitter amazed the monitoring team by sending clear speech to Sydney from as far south as Gabo Island.

Radio telephony was given its first public demonstration on August 13, 1919, when Ernest Fisk addressed the Royal Society of New South Wales, ending his lecture with a recording of the National Anthem played on a hand-wound gramophone five city blocks away. The tiny transmitter used in the coastal tests was again pressed into service, feeding a T aerial on the roof of "Wireless House." As no loudspeakers were available, a number of Baldwin earphones, hastily fitted with tin horns, were strung along the ceiling of the lecture hall. Everything worked splendidly. For the first time in history an Australian audience stood to attention as a recorded orchestra played the National Anthem by radio. Perhaps the sharpest response came from the Government, which promptly amended the Wireless Telegraphy Act to give the Commonwealth control of radio telephony.

The next step was to convince Australia's lawmakers of radio's capability. Two Marconi ½kW speech transmitters were imported from England and one was installed at the Middle Brighton home of AWA's Melbourne Manager, Lionel Hooke. On October 13, 1920, a distinguished audience of parliamentarians and their guests crowded Queen's Hall and listened in awed silence to an entire program from Hooke's drawing room, the first Australian broadcast to feature a live artist. Some astute politicians quickly sensed radio's value for dispelling the isolation of outback settlers.

More than a year after the war ended, wireless was still under Navy control and



Australia's first locally made valve, the AWA "Expanse B" of 1920. This valve is now a valuable collector's item.

At left, Charles Maclurcan, Australia's acknowledged pacesetter in amateur radio of the 1920s. Above shows Eric Burbury testing components in the AWA Laboratory, Sydney (1924), whilst below is a 1924 photograph of the 2FC broadcast studio.

amateur radio was a wasteland. Not surprisingly, there was mounting pressure for the PMG to take it over. Faced with this loss of authority, the Navy complained that any change in the status quo could result in naval dispositions becoming "known to the enemy at the outbreak of the next war." Despite these protestations, the Postmaster-General resumed control of wireless and the amateur fraternity set about exploring the applications of the triode valve. Australian valve manufacture commenced in 1920, when AWA began making the double filament Expanse B. A "soft" valve, its performance improved measurably when the first filament burned out, thus increasing the vacuum. David Wyles was in charge of the Expanse B project, assisted by chemist Wallace McSkimming.

As the amateur movement gained momentum, many electrical traders began stocking radio components as a sideline and dispensing advice to experimenters. Within a few years some of those traders helped to launch broadcasting. The hobby, incidentally, was not entirely a masculine preserve because Sydney could boast a lady wireless dealer, Miss F. V. Wallace, who was a licensed electrician.

Early in 1921 AWA, using a ½kW Marconi transmitter, initiated weekly broadcasts of recorded music for Melbourne experimenters. For a time Sydney Newman ran this "concert service" from his suburban home on 1,100, and subsequently 400, metres, using the call letters 3ME. The duration of each concert was about an hour, after which the energising current began overheating the carbon microphone. One wonders if this was the origin of announcers' hoary jokes about slaving over a hot microphone!

A similar service was later provided for Sydney's amateurs from a makeshift studio in AWA's Knox Street factory. It was conducted by Alton Vipan, whose long experience in wireless included being rescued from the torpedoed "Aparima," still wearing his operator's headphones.

There was a growing demand, especially among experimenters, for the introduction of broadcasting. The United States was the clear leader, with conservative Britain watching to see what mistakes the Americans made. Australia was blandly content to follow Mother England. Meanwhile, radio telephony demonstrations continued to introduce many people to the medium. Probably the most ambitious broadcast of that era was on March 31, 1922, when Lionel Hooke transmitted a program by top professional artists from the stage of Her Majesty's Theatre, Melbourne, for the entertainment of convalescent ex-servicemen.

Licensed amateurs were rapidly becoming a potent force — Culliver and Howden in Melbourne, Maclurcan and Pike in Sydney, Hume in Adelaide, McDowall in Brisbane and Coxon in Perth. Charles Maclurcan was Australia's acknowledged pacesetter. This pre-war pioneer of spark transmission was converted to radio telephony by C. V. Stevenson, a Sydney electrical trader and the original licensee of 2UE. Maclurcan's station at Strathfield, 2CM, enjoyed a far-flung audience for its regular Sunday night gramophone concerts, which were advertised in the press. Perhaps Maclurcan's most memorable coup was a broadcast by musical comedy star, Josie Melville.

Other leading amateurs of that period included Ray Allsop, R. R. (Jack) Davis, Oswald Mingay, Otto Sandel and Len Schultz. Sandel was an innovator, as the output of his station 2UW proved, and Schultz quickly graduated to professionalism by helping to build two commercial stations, 2KY and 2GB. He became

Radio pioneers

chief engineer of the latter. The amateur fraternity achieved further recognition in August, 1922, when another experimenter, W. J. Maclardy, established "Wireless Weekly," the first regular radio journal in the southern hemisphere. In the second issue Maclardy trumpeted . . . "wireless telephony is now out of its experimental stages and it is time the authorities came to realise this." The active campaigning for broadcasting was hotting up.

Oswald Mingay, secretary of the Wireless Institute, organised Australia's first radio exhibition in September, 1922, at a Sydney church hall. The function enjoyed a vice-regal opening and gave a host of curious visitors their first audition of radio music.

Other interesting developments of that period were radio clubs, where young men of modest means could pool their skills and resources to build club sets and spend their evenings logging reception of amateur transmissions. By September, 1923, no less than 37 of these clubs were flourishing in New South Wales alone.

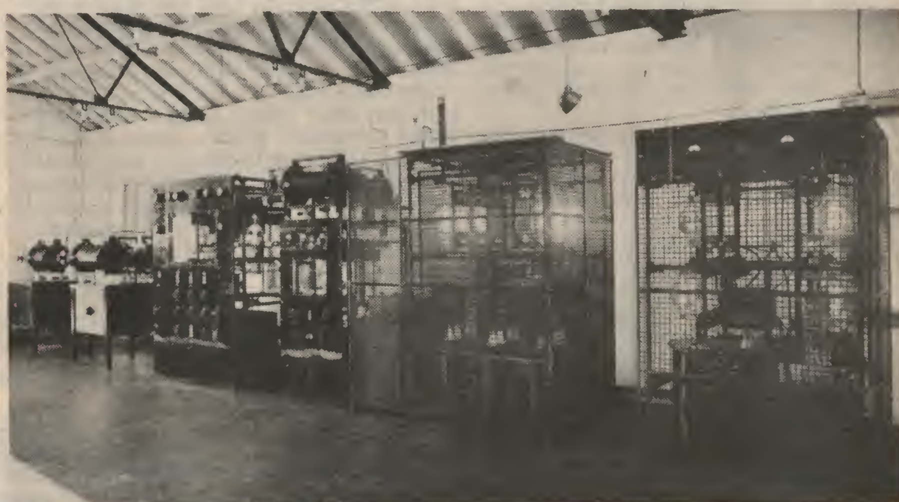
Despite endless talk about broadcasting, officialdom seemed in no hurry to introduce it. Someone had to take the initiative. Documents of that era show that AWA served the first volley on November 1, 1922, by formally applying to establish stations. Thereupon the Government issued revised wireless regulations creating a new licence category — "Broadcasting Stations."

The origins of our broadcasting system were publicised widely during the 1973 golden jubilee, so most readers probably know that Australian broadcasting was launched with "sealed sets." In addition to purchasing a Government licence, listeners were required to subscribe to a program service of their own choice, their sets being sealed by the PMG's Department to receive only the nominated stations. Four stations in three States commenced operation under this scheme — 2SB (later 2BL) and 2FC in Sydney, 3AR in Melbourne and 6WF in Perth. The sealed set was short lived. A mere 1,400 listeners throughout Australia bought licences, although innumerable others, including a small army of artful schoolboys, built "open sets" and listened to whatever took their fancy.

A change was overdue and in July, 1924, new broadcasting regulations created two distinct categories of stations, A Class and B Class. Payment of a licence fee permitted the public to listen without restriction, and so Australia's dual broadcasting system began. A number of advanced experimenters acquired B Class licences and those with a flair for show business soon made their presence felt. Otto Sandel, for instance, demonstrated considerable resource in his conduct of 2UW and even broadcast the first political programs.

Amateur radio began to take wings during the early 1920s. A series of trans-Pacific tests in 1923, when many American stations were logged, raised the question as to what distances could be achieved on low power. AWA arranged for Maclurcan and "Jack" Davis, then a teenager, to travel to America and back aboard the "Tahiti" using a small 10 watt transmitter of Maclurcan's own design. The results exceeded all expectations: with a power of only 7.6 watts, coded

The photograph above shows a corner of the transmitter hall at the AWA Radio Centre, Pennant Hills (1927). Below is the original 5kW transmitter of 2FC, Sydney.



Morse was received right across the Pacific to San Francisco, and voice and music up to 4,800 miles.

In November, 1924, Maclurcan logged his first CQ from an American "ham," 6EKY . . . "called him back on 90 metres and he replied immediately. My hand trembled so with excitement that I could hardly separate the dots from the dashes." The same month he transmitted the first amateur greeting from Australia to King George V through 2OD, England. Maclurcan's next triumph was the first 20 metres communication with England using 50 watts of power.

Even assuming that they could be verified, it would be pointless to begin listing the DX achievements claimed by amateurs of that period, but no one has ever questioned Charles Maclurcan's primacy. He remained the paterfamilias of our amateur scene until 1927 when, like Alexander the Great with no more conquests to make, he retired from experimental activities.

One major promotional undertaking of that decade is worth mentioning, because it gave countless country families their first taste of radio. During 1925-6 the Great White Train toured New South Wales advertising Australian-made products. AWA's carriage was equipped with a ½kW transmitter, 2XT (for Experimental Train), operating on 850 metres and at each stop, as local dignitaries welcomed the train, the proceedings were broadcast. 2XT was under the charge of a former marine operator, Harry Tuson, whose odyssey on this puffing iron horse was responsible for introducing many Australians to radio.

Public interest in broadcasting assisted other facets of radio. As dealerships multiplied a wider range of components became available, and, in response to popular demand, radio journals devoted more space to technical articles. Another source of enthusiasm stemmed from some high school science teachers, who formed radio clubs and initiated their students into the new science of electronics. Many found it so fascinating that it claimed them as staunch devotees.

Solar energy may heat and cool our homes

Solar energy: it's an aesthetically attractive concept. Whole communities of the future could derive all their electrical and heating requirements from the sun, easing our dependence on fossil fuels and providing other economies. In this article, the author examines the progress made in this field and discusses several solar energy concepts that have emerged in the United States.

By C. P. GILMORE

The temperature was 18 deg F and plunging. A gusty wind was swirling through the scrub trees and clumps of grass clinging to the hillside in the high desert country an hour's drive from Albuquerque as I hurried from the Citroen across the dirt drive and into the 31-foot white dome.

Inside, the 68 deg F temperature felt especially satisfying because no fuel had been burned to generate it — except 93 million miles away in the sun's thermonuclear belly.

Several electric lights illuminated the dome brightly. The record player was turned up too high; someone cranked it down as I was introduced. Yet no utility line comes onto the property. Three wind machines outside, a bank of storage batteries, and solid-state power conditioning equipment supply all needed electric power, both to the dome and to the nearby design facility containing workshop with power tools, kitchen, electronics shop, darkroom, and drafting rooms. I was in the world's only 100 per cent solar-heated, wind-powered residence.

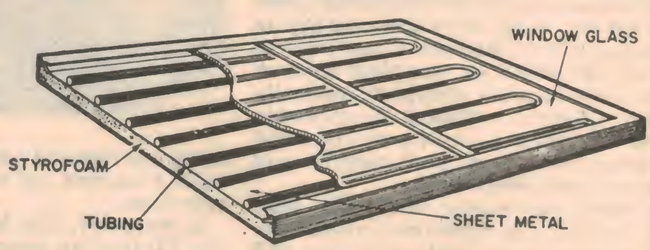
The dome, a working laboratory that also serves as home for project director Robert Reines, is the main exhibit of Integrated Life Support Systems Laboratories, a private research organisation trying to develop — among other things — solar-powered housing, including entire communities. And they're not the only ones. I've just made a swing around the country visiting a crop of new — and not so new — solar homes. Spurred by the energy crunch, the solar energy research field is hopping. For example:

- The National Science Foundation has just awarded three university-industry teams $1.5 million for solar technology research to enable them to recommend plans for building solar homes.
- NASA has announced plans to build a 53-000-square-foot engineering building at Langley Research Center in Virginia that will be heated and cooled by solar energy.
- A move is under way in Congress to appropriate the money to build 2,000 solar homes right away.
- And interest is high among professionals: at a recent mechanical engineering conference in Detroit, the solar-energy presentations were among the most popular, drawing large crowds for every session.

The idea of heating houses by collecting solar power has been an attractive concept ever since researchers figured out that the sun is pouring energy into the earth at the incredible rate of 1kW per square metre. The first real attempt to grab some of this free energy for home heating and hot water came in 1938 when a research team at the Massachusetts Institute of Technology (MIT) built the first of four solar homes.

The basic approach worked out then is still the same today, though with some minor variations. When a piece of black metal is placed in the sun, it will absorb energy in the form of visible light radiation from the sun, becoming hot in the process. To prevent this energy from being-re-radiated in the infrared spectrum, the plate is covered by glass. Glass is transparent to visible light, but is opaque to infrared radiation. Heat absorbed by the plate is transferred to either water or air circulated through flow passages behind the plate to a storage tank.

A typical solar collector contains a black metal plate to absorb energy from the sun, copper tubing to enable the heat generated to be transferred, and a glass cover to stop radiation of infrared energy.



The MIT houses used water as the heat-transfer fluid, then used the hot water both for domestic purposes — clothes washing and bathing — and for heating the house. Auxiliary heat for prolonged spells of cloudy weather was supplied by a regular furnace. Somewhere in the vicinity of 25 solar-powered houses have now been built across the United States, and following is a description of some of the most interesting.

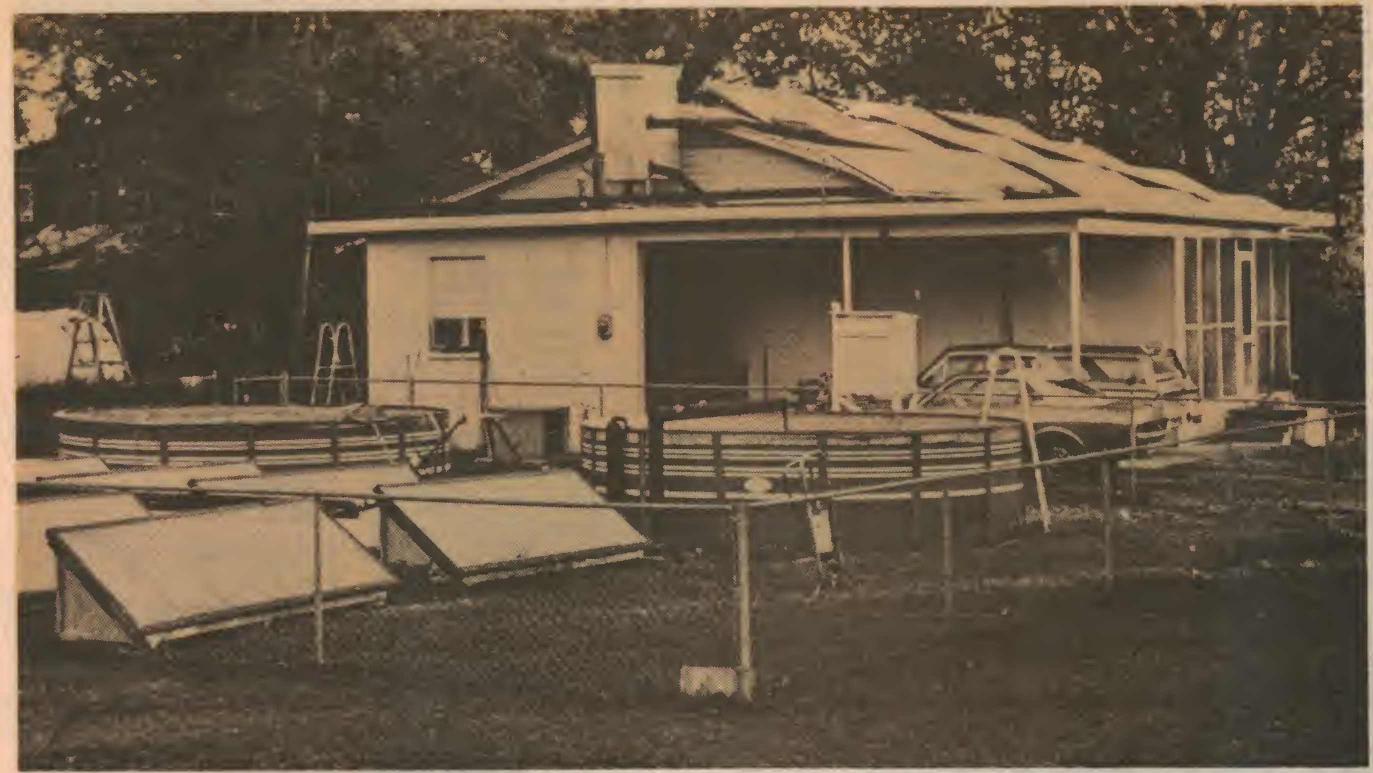
Many years ago, a Washington patent attorney named Harry Thomason was caught in a sudden shower on a farm in North Carolina. Taking shelter under a shed with a rusty tin roof, he noticed that the runoff was hot. That started him thinking, and in 1959 he built a small home near District Heights, Maryland, just two miles from the Washington DC border, making use of that lesson.

The south slope of Thomason's roof is covered with black, corrugated aluminium, backed by a slab of insulation. An inch above the aluminium is window glass. At the peak of the roof is a galvanised pipe with a string of holes along one side. Each hole is aligned so that a small jet of water shoots into each corrugation, runs down the slope picking up heat from the hot aluminium, and drains into a trough at the bottom. The trough leads to a pipe that takes the water down into a 1,500-gallon tank in the basement. The tank, in turn, rests in a bin filled with 50 tons of egg-sized stones. The water, usually at a temperature of 125 to 135 deg F, heats the stones packed around the tank. Thomason blows air from the house heating system through the stones where it picks up heat. Two thermistors constantly measure temperature of the roof and the water in the tank. As long as the roof is hotter than the tank, water circulates. When the roof cools, circulation stops. The system can therefore collect some heat on cloudy days even if the water is relatively cool.

The water tank and stones serve as both heat exchanger and heat storage. Thomason figures he can collect enough heat in one sunny day to last for two days, and the house can coast for four cloudy winter days on stored heat.

If too many cloudy days come in a row, an auxiliary oil burner comes on. During its first three years, Thomason's house cost $18.45 to heat; similar homes in the cold Washington climate cost several hundred dollars. Since then, Thomason has built two more solar homes, including the one in which he now lives.

In his new house, Thomason has added some refinements. In the summer, he runs an air conditioner at night when the load on the utility is at a minimum and the outside air temperature is low. This increases the efficiency of his air conditioner, perhaps by as much as 100 per cent. Cool dry air from the air conditioner is pumped through the bin, cooling and drying the stones in the process. Then in the daytime, the house air is cooled and dehumidified simply by



This solar powered house is at the University of Florida. Note solar collectors on the roof and on the ground.

pumping it through the bin and recycling it through the house.

In sharp contrast to Harry Thomason's "seat-of-the-pants" design is what must be the most technologically advanced solar home now in existence. Constructed as a research project at the University of Delaware, the house utilises cadmium sulphide solar cells mounted on 4 x 8ft roof panels to convert solar energy directly into electricity. Heat absorbed by the solar cells is transferred to air circulated in passages behind the panels, which in turn is piped to the basement where the heat is extracted and stored. "This is the first house in which there has been a substantial effort to collect both electric and thermal energy," says Dr Karl Boer, head of the University's Institute of Energy Conversion.

The sophisticated storage system was developed by Dr Maria Telkes, a solar pioneer associated with some of the early MIT houses. It is made up of bins containing plastic tubes of eutectic salts — chemicals with a melting point in the range needed for home heating. When any solid melts, it absorbs a large amount of heat as it goes from the solid to the liquid stage, yet does not change temperature. When it returns to the solid state, it gives up the heat, again remaining at constant temperature.

The Boer house contains three such bins. One has a melting point at 125 deg F and is used to store solar heat during the winter. (A heat pump supplies auxiliary heat during prolonged cloudy spells.) Another has a melting point of 50 deg F. During clear summer nights, the roof panels radiate to the night sky. Air passing behind the panels is chilled and circulated through the 50 deg F salts to extract the heat. On cloudy nights, the salts are chilled with the heat pump. Then, during the daytime, air circulated through the salt bin is cooled.

A third bin contains 75 deg F salts. Drs Boer and Telkes call it a thermal flywheel; when the house temperature rises this bin absorbs heat and cools the air. When the house cools, the bin gives back its heat.

Electric energy from the solar cells is stored in lead-acid auto batteries and used for lights and other purposes where DC energy can be used. Ultimately, such a house might contain equipment to change DC into 115-volt AC.

The Delaware House is a sophisticated example of what solar houses may one day become. But such a system is far in the future, and many problems remain. The main one, perhaps, is the solar cells themselves. Dr Boer hopes that his cadmium sulphide cells will eventually be cheap enough for such use, but no one knows for sure just how much they will cost and how long they will last. The eutectic-salts heat-storage system has some unsolved problems, too.

One of the oldest solar houses in operation is just off the campus of the University of Florida in Gainesville. It was built 18 years ago by the mechanical engineering department to measure heat flow into and out of a home and was converted to solar heat five years ago. When I was there one cold, rainy day this winter, water in the tank had been keeping the house warm, yet remained at 120 deg F.

Now Dr Erich Farber and his associates are planning to install an absorption air conditioner that will operate on the heat from the solar collectors.

Another promising solar house concept has been developed by Harold Hay, a chemist and building materials expert. Some 20 years ago, Hay was in India on a technical aid mission for the US Government and noticed that many of the people lived in rusty sheet-metal shacks which were hot during the day and cold at night. "I realised that even if such houses had insulation," he recalls, "it would be in the wrong place half of the time. What was really needed was insulation on wheels."

Hay's idea was to be able to remove the insulation from the roof on winter days so the roof would get hot and heat the inside of the house. Then the insulation would be put in place on top of the roof and the heat would be retained through the night. During the summer, the reverse would happen, letting the house cool at night and replacing the insulation in the daytime to keep out the heat.

Over the years he refined the idea, and in the late 1960s, Hay and John Yellott, a solar-heating authority and now visiting professor of architecture at Arizona State University, built a 10 x 12ft rectangular building with a flat water tank on top. During the summer, the slab of foam insulation was rolled back at night and the water became cold. Since this reservoir sat directly on a metal ceiling, it absorbed heat from the room and kept the building air conditioned all day. During the winter, it was opened during the day to collect heat. It then radiated enough heat into the house through the ceiling at night to keep the room comfortable.

The concept was a spectacular success. "When the temperature outside was 95 deg F," recalls Hay, "I had to wear a sweater and coat inside to stay warm."

But despite the success, Hay had trouble getting anyone interested in building a full-scale house. Finally, he put together a design team headed by Professor Kenneth Haggard of California Polytechnic State University at San Luis Obispo and got a government grant of $40,000. That was just enough to pay for data collection, so Hay borrowed money and paid for construction of the house himself.

It was finished in August, 1973, and a family with three children moved in soon after. As you drive up to it, the building gives no hint that it is very different from other homes on the block. But it is. Hay led

the way up a ladder to the roof and the difference was evident. Bags of water 40 feet long, eight feet wide, and slightly less than a foot deep fit into frames built to hold them. Telescoping polystyrene panels can cover the water bags or open them to the sky. Automatic controls are used to sense air and water temperatures, and move the panels as needed to provide either winter heat or summer cooling.

Preliminary data indicates that the patented system will be able to supply all summer air conditioning and most of the winter heating requirements — all with a simple waterbed roof.

Undoubtedly, the most ambitious system I have seen is the one built by ILS Laboratories in New Mexico. Most solar houses now being built are designed to collect only part of their heat and energy requirements from the sun. And, of course, almost all still counted on the central power station for electricity. The ILS installation on the other hand, gets all of its power from the sun and wind.

The design is strictly no-compromise. The dome is a steel shell lined with three inches of plastic foam. Windows are small — a series of portholes. Cooking is done with a microwave oven, as these require less energy than conventional ovens.

Robert Reines, director of the laboratory, told me that the building stayed comfortable during the most severe spell of weather yet experienced: ten cloudy days with the temperature hovering around 10 deg F in the daytime and below zero at night.

It differs in yet other ways: most of the houses around the country are prototypes, designed to demonstrate how much solar homes can be like conventional houses. But not the ILS house. "This is a physics experiment, it's our scratchpad," says Reines.

Despite these achievements, some of them quite impressive, solar technology has yet to be implemented on a large scale. Although the current technology works it is still open to improvements, both efficiency and cost wise. Solar collectors, for example, have usually been built by soldering copper tubing onto copper sheets, then painting the whole thing black. "What we may be using is welded sheets of steel inflated with high-pressure nitrogen after the tube pattern has been created by welding," says John Yellot. Yellott also believes that improvements will have to be made in heat storage techniques.

Up until now, cost has been the major factor holding up solar technology application on a large scale. Solar collectors are relatively expensive and many systems are experimental, whilst conventional fuels — gas, oil, and coal — were cheap and plentiful. However, this situation has changed as a result of the so-called energy crisis.

There are, however, other reasons. "Solar apparatus in the past has been so ugly," says Yellott. "And when it has been tacked on to a house it looks just that way: tacked on." In addition, many people resist change, particularly to a new and untried technique. That's why so many studies these days are looking into the problem from every point of view. At the University of Delaware, for example, 16 departments contribute to the solar project. Involved are not only such expected experts as physicists, chemists, and engineers, but psychologists, economists, and architects.

The cost problem may be fading into the past. "We're just around the corner from economic feasibility, thanks to the Arabs," says Yellott. Boer thinks we've turned the corner. He estimates that his house would cost 10 per cent more than a conventionally heated and cooled house — but would easily save its cost in unused fuel. Dr Farber estimates that his system in a totally heated and air-conditioned house would cost perhaps $5000 more than a conventional one. And Harold Hay estimates that the new equipment on his house would cost no more than the furnace and air conditioning systems it replaces.

Whatever the case, the price problem is slowly fading away. And so is another problem area that has kept solar houses from being built. Traditionally, the vast majority of homes are built by developers. And developers are primarily interested in keeping first costs as low as possible. But that situation may be changing. In Phoenix last December, a large home builder was one of the principal sponsors of a seminar on solar heating. "He is aware that the next large tract he builds," says Yellott, "he probably won't be able to get natural gas. Maybe he'll have to go to solar energy or heat pumps. But he's got to find something new — even if it costs more — or he's out of business."

The pressure to get solar housing in operation is growing. Fuel costs are high and still rising. And some people believe we should stop burning current fuels such as oil or gas, even if they were available, since they're used to make everything from fertiliser to plastics.

Nevertheless, some experts are sceptical. Dr Hottel, who built the original MIT house 35 years ago, recently warned his colleagues not to lose their heads and underestimate costs and difficulties. Robert Reines says that the real difficulties of manufacturing working systems economically have not even been dealt with. He also points out that most of the work being done these days is aimed at the $40,000 and up upper-middle-income house, but that the real need is for designing good, inexpensive systems and houses wage earners can afford.

But others are brushing aside such objections and are anxious to get started. "We have had more than enough paper studies already," says Dr Farber. "We have more than enough knowledge to build these things and put them into operation."

Not everyone agrees, but here's one optimistic estimate: "Solar heating, three to five years from now," says Boer. "Solar air conditioning, four to six years. And if we're given enough money, electric power from solar cells in a decade." Adds John Yellott: "The inexorable forces of economics will bring about the age of solar energy."

Reprinted from Popular Science, by arrangement.

NASA develops new solar panel coating

A special absorptive coating for aluminium panels, used in the construction of solar energy collectors, has recently been developed by NASA. The new coating is one of several unique features permitting the efficient operation of a solar heating and cooling system currently being demonstrated at the NASA Marshall Space Flight Center, Huntsville, Alabama, in a simulated residence.

The coating, invented by James R. Lowery, an engineer at the Center's Astronautics Laboratory, absorbs about 93 per cent of the total heat energy available. Only about 6 per cent of this energy is re-radiated in the form of infrared radiation. Heat absorbed by the panels is transferred to cooling water circulated through flow passages to a storage tank for use in heating and cooling the residence.

The MSFC demonstration heating and cooling system collects sufficient energy from the sun during the winter months to produce 20.5kW, and produces enough surplus energy for operation over three successive cloudy days. Major components of the system include a 1,300 sq ft solar collector on the southern side of an "A-frame" roof, a storage tank, pumps, coils, a modified Serval air-conditioner, an auxiliary heater and automatic controls.

The solar collector consists of 31 modules, each two feet wide and 21 feet long, consisting of aluminium panels with lengthwise corrugations. The aluminium panels, coated with the special absorptive coating, are sandwiched together to form channels, or pipes, for the water. The transparent outer cover is a composite material composed of Tedlar and steel wire.

Water-bag heat absorber / radiators, similar to that shown at right, are used to line the roof of the solar house developed by Harold Hay. The water-bags radiate heat into the house in winter and absorb heat in summer.

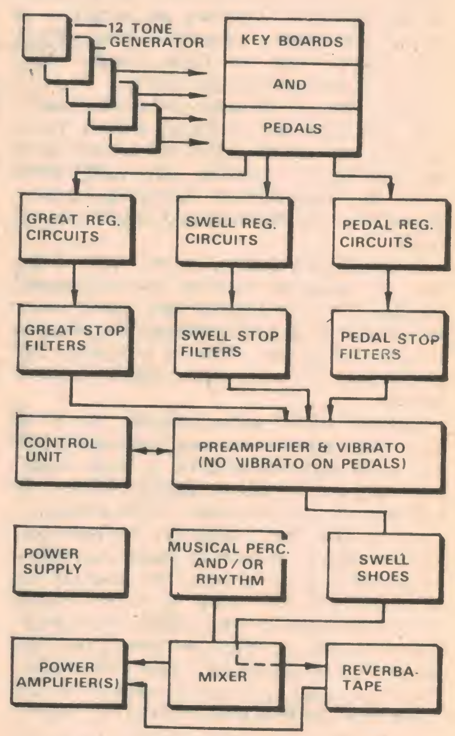
Cover feature:

Building your own electronic concert organ

At left, the Schober Recital Organ, fitted with optional chime manual, and the full range of presets. Below is the block schematic indicating the major sections in the instrument.

For those who may be aspiring to build their own electronic organ, we reprint here some of the circuits used in the current Schober Recital model. Designed around discrete transistors, the circuitry can readily be examined to extract principles and ideas.

by NEVILLE WILLIAMS



While the vast majority of electronic organs in use are standard big-name models, purchased off the showroom floor, there have always been those who have preferred to build their own, ranging from little more than hobby efforts to very pretentious instruments to classical standards.

The urge to build one's own organ may flow from one or more motivations:

1. A desire to be creative and for the interest and pleasure it affords;
2. A conviction that one might end up with a better instrument for a given outlay.
3. An ambition to own an instrument biased towards personal preferences.

Of all the companies which have become involved in the do-it-yourself area, probably the most notable is the Schober Organ Corporation, under its president: Richard H. Dorf, well known as a writer and author of several books on the subject of organs.

At present, the Company markets kits for four different instruments: the Recital model intended mainly for serious classical music; the Theatre organ, styled and voiced in appropriate fashion; the Consolette II, a versatile home-style instrument; the Spinet, for homes and small churches.

In addition to the basic organs, the Company has a variety of ancillary units intended to extend the scope and appeal of their instruments.

Being as much an enthusiast as a business man, Richard Dorf has never been backward in publishing his circuits and there is no doubt that ideas have been translated from his books and articles into an endless array of distinctive individual instruments.

But equally, they have also induced many would-be designers to settle for a Schober kit, at least as a very comprehensive starting point for a personalised instrument.

It is against this background that Richard Dorf, through his Australian company, offered to "Electronics Australia" the exclusive right to publish the basic circuitry of the current Recital model, as pictured.

This instrument has two 61-note manuals and a full pedal board to A.G.O. specifications. The swell (or upper) manual has two 16ft stops, six 8ft, three 4ft, two 2ft and one 2-2/3ft—all stops with classical voicing and nomenclature. The great (lower) manual has one 16ft, four 8ft, two 4ft, one 2ft, one 2-2/3ft and one mixture. The pedals provide three 16ft, two 8ft, two 4ft and a 2ft "Zink". (Everything — and the kitchen zink!)

In addition, there are six couplers, provision for seventeen presets, and a number of controls for balance, vibrato, etc. Additional options range from musical or automatic percussion to a chime keyboard.

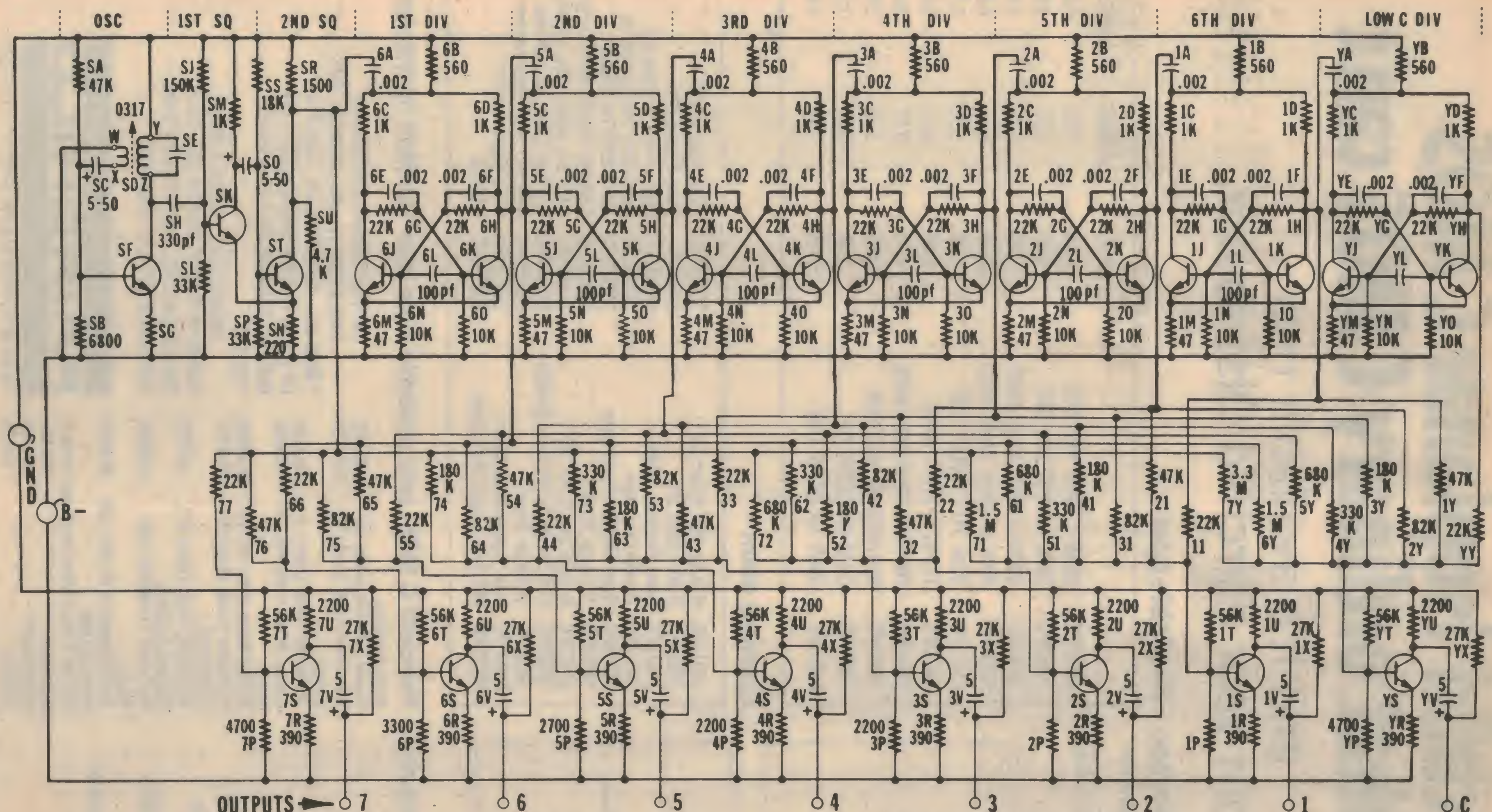
The accompanying block diagram shows the general electronic planning of the instrument.

Twelve tone generators provide all the basic pitches, footages and waveshapes required for the organ.

Each generator contains a tuneable master oscillator, followed by a buffer and seven flip-flops producing square waves. These are matrixed to produce "staircased" triangular waves, which are fed through buffer stages to the generator output terminals.

Output from the generators passes to the keyswitches operated by the keyboards and pedals. There are five busbars per keyboard (one for each basic footage) and five gold-plated spring wires per key, which couple the appropriate generator output to the respective busbars when keys are depressed.

The circuit information on these pages is presented by arrangement with the Schober Organ Corporation, but neither the Company nor "Electronics Australia" is prepared to enter into general correspondence regarding design details. Schober Organs (Aust) can supply complete kits for any of the organs mentioned, or for complete sub-assemblies; components, wiring boards, patterns, etc, are not available separately. Address in Australia: Schober Organs (Aust), 124 Livingstone Ave, Pymble, NSW 2073. Contact by mail only.

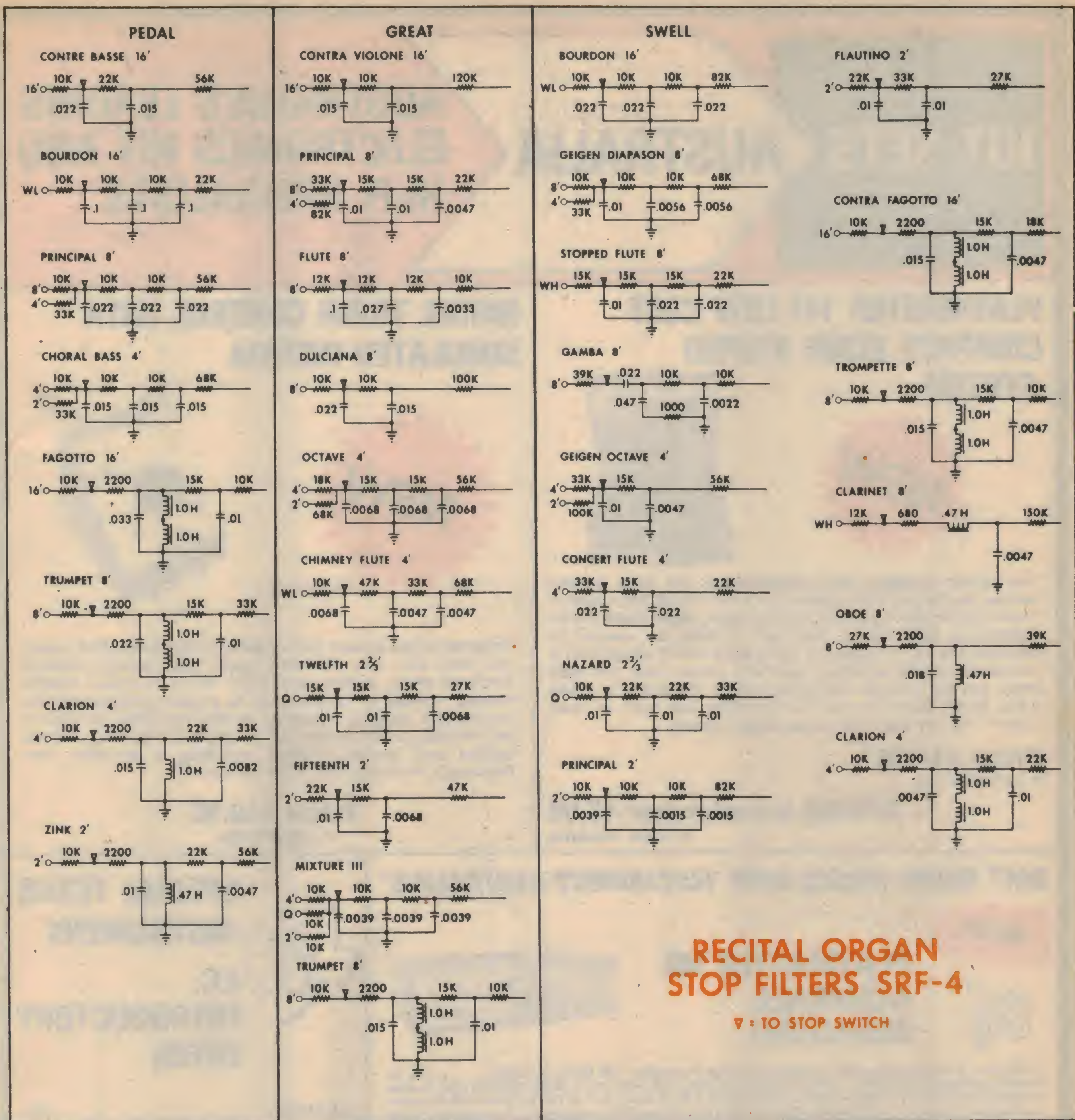


	C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
SE	.0082	.022	.018	.018	.015	.015	.012	.012	.01	.01	.0082	.0082
SG	2700	1500	1800	1800	1800	1800	1800	1800	2200	2200	2700	2700
2P	2200	3300	3300	3300	3300	3300	2700	2700	2700	2700	2700	2700
1P	3300	4700	4700	4700	4700	4700	3900	3900	3900	3900	3900	3900

TONE GENERATOR

TRG-5

Circuit details of a generator board, of which there are twelve in the organ. Each produces the full range of footages for one key name on the manuals, viz: C, C-sharp, D, &c. The twelve generators are symmetrical apart from the changes listed, made necessary by the fact that the generators have to produce twelve different sets of frequencies. At the top left is the master oscillator, which must be tuned to provide the precise frequency required in each case. Output from the master oscillator passes through an isolating buffer stage to a chain of seven 2:1 frequency dividers, which produce square waves. These are not used directly but are combined or matrixed in a ratio which will produce a "staircase" or approximate triangular waveforms which are fed through the bottom row of transistors to the output terminals. All transistors are small signal NPN silicon types. The organ operates from a minus 18.5V rail, from a single protected power supply.



RECITAL ORGAN STOP FILTERS SRF-4

▽ : TO STOP SWITCH

The tone or "formant" filters which transform the angular waveforms from the generators into signals which can simulate classical organ voices. The filters strongly attenuate higher harmonics to produce the richer organ tones, or favour them to achieve a "string" effect, or emphasise a band of frequencies to imitate certain solo wind instruments.

ambitious instrument. It is desirable to buffer the inputs and outputs to minimise interaction and loading on the respective circuits, and to consider impedance levels, signal amplitude and signal phase. In essence, the three registration modules add up to fairly complex electronic mixers, with tab switch controls accessible to the organist.

The registration system in the Recital organ performs one unusual function: where a woodwind is called for, the registration circuit selects staircase waves from adjacent octaves, inverts the phase of one of them and combines them to reconstitute a square wave — the basis of simulated woodwind sounds. The designers have presumably considered it easier to do this than to provide keying access to the square waves in the generator boards. Thus the registration circuits deliver square and staircased waves, as required.

From the registration circuits, one each for the manuals and the pedal clavier, the signals pass to the stop filters. These variously modify the angular waveforms from the generators into signals appropriate for the kind of sound required.

The signals then pass into a preamplifier system, with which is associated vibrato and control circuitry. The vibrato (or phase / frequency modulation) can be applied as desired to the manuals but but not normally to the pedal notes. The control functions, accessible on the console, permit selection and adjustment of vibrato and balance between manuals and with respect to pedals.

A pair of swell pedals provides a volume control function before the signal passes into a mixer unit and thence into the main amplifier system.

At the mixer, the signals can be diverted through a Schober "Reverbatape" unit. As the name suggests, this is an artificial reverberation system relying on magnetic tape rather than the more usual com-

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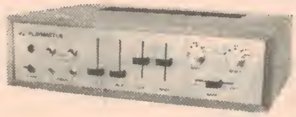

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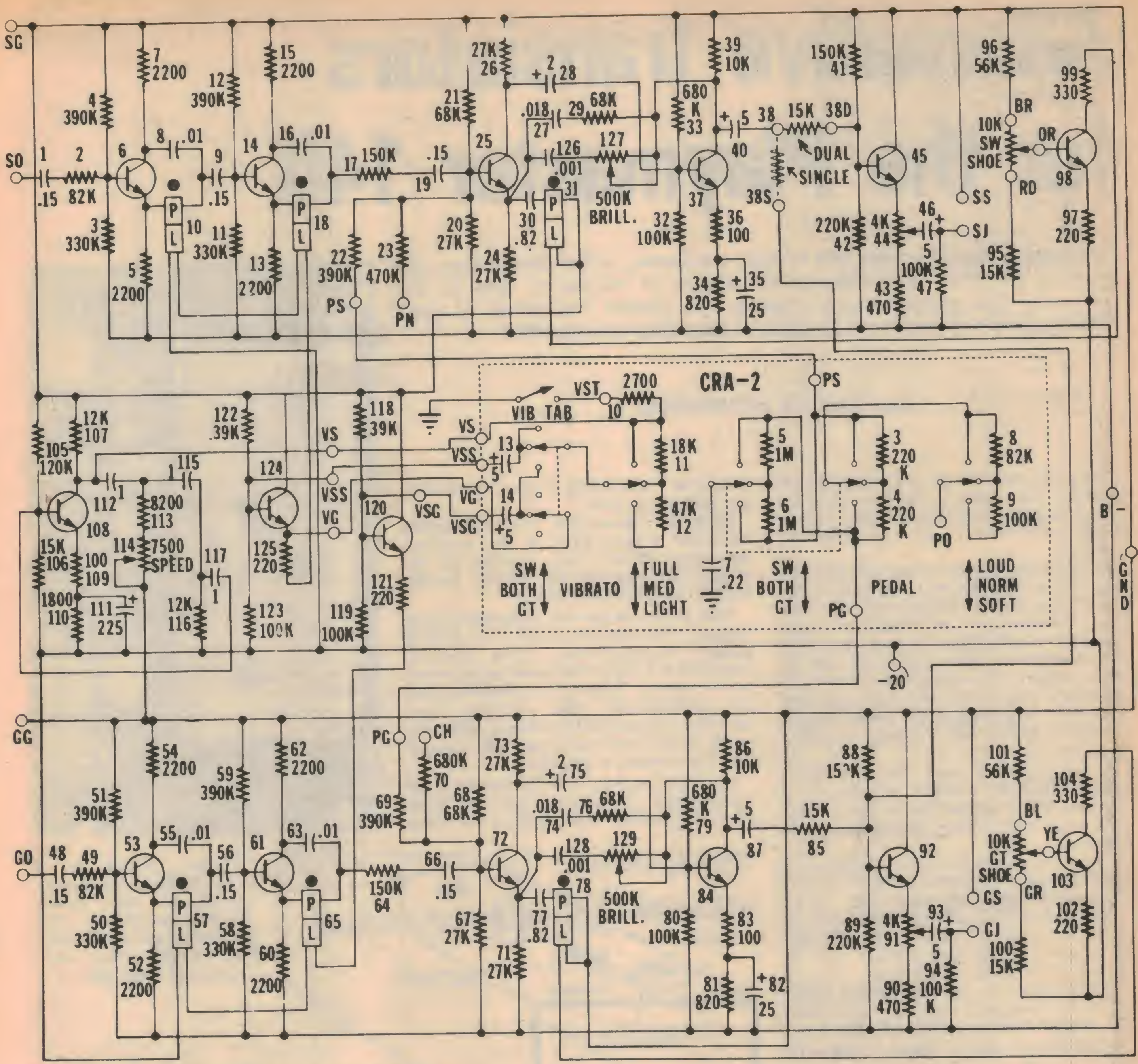


PREAMPLIFIER-VIBRATO UNIT PRR-6

The swell manual (SO) and great manual (GO) go to separate preamplifiers, each involving an LDR controlled phase modulator, driven by the oscillator stages, centre left. The vibrato can be switched on and off, varied in speed and depth and used with either or both manuals. Signal from the bass pedals, via input PO, can be preset to the desired level and directed to either or both output channels.

bination of coiled springs and transducers.

In the Reverbatape unit, an endless tape loop passes over an erase head, a record head and a closely spaced series of replay heads. When a note is played on the organ, it is recorded on the tape and is repeated from the playback heads as a series of distinct echoes. In fact, these signals are fed back again into the record system to produce a more random echo effect, which can be introduced into the amplifier system, via the mixer, at the discretion of the organist.

The Reverbatape can be set to produce an extremely long reverberation period, up to six seconds, in fact.

It is noteworty that the Recital organ does not have provision for note sustain and this would underline the need for some form of artificial reverberation in limited environment of a home or small auditorium. The Reverbatape unit would therefore appear to be an essential item, rather than a listed option.

Optional extras on the Recital organ are musical percussion, and / or the "Dynabeat" rhythm unit. These signals are introduced directly into the mixer in such a way that they do not pass through the reverberation system. They are also independent of the swell shoes, having their own level controls.

A fully regulated power supply completes the block schematic.

No attempt has been made in this article to give details of the keying or tab wiring and other mechanical data. To do so would require a manual, not an article in a magazine! But, if you are an organ fan, the foregoing circuitry will give you something to "chew on".

FOOTNOTE:
Additional information can be obtained by mail only from Schober Organs (Aust), 124 Livingstone Ave, Pymble. NSW 2073.

- Detailed catalogue: enclose 20c stamp for postage.
- Demonstration 10in LP recording SOC7 covering all models: $3.50 posted.
- "How Schober Organs Work" by Richard Dorf, containing typical circuitry and explanations: 50c posted.
- "What Is An Electronic Organ?" by Richard Dorf, explaining basic principles: 25c posted.
- "Electronic Musical Instruments" by Richard Dorf, hard cover basic textbook, 393pp: $10.00 posted.

Alternative transistors for the Playmaster 140

The changed manufacturing and marketing situation, which flowed from the lowering of tariffs, has affected the supply of transistors used in the Playmaster 140 amplifier power modules. We present here details of alternative types which can be used in place of those originally specified.

by DAVID EDWARDS

The power modules in the Playmaster 140 amplifier were based on circuitry which we first presented in September 1972, in connection with the Playmaster 135 Utility PA Amplifier.

Of particular interest at the time were the two output transistors, Fairchild types AY8171 and AY9171. Employing what was then referred to as "bimesar dual-epitaxial" construction, the two transistors were notable for their ruggedness and for their ability to withstand short-term overloads. This made it practical to operate them from a non-regulated power supply, protected only by fuses against an output short-circuit.

In addition, they were offered to Electronics Australia readers as part of a complete set of transistors for the module, at a price which made them uniquely attractive.

The same transistors were used again in the Playmaster 136 stereo amplifier, and in the quadraphonic Playmaster 140.

Then came the tariff cuts, which put at hazard the vital Australian-produced output transistors AY8171 and AY9171 and, of course, the designs using them.

Fortunately, in the meantime, other manufacturers have come up with power transistors which are similarly rugged and competitive in price. These, along with alternatives in the earlier stages, have eliminated dependence on the Fairchild range, and ensured the continuity of what has proved to be a very economical and very popular power module.

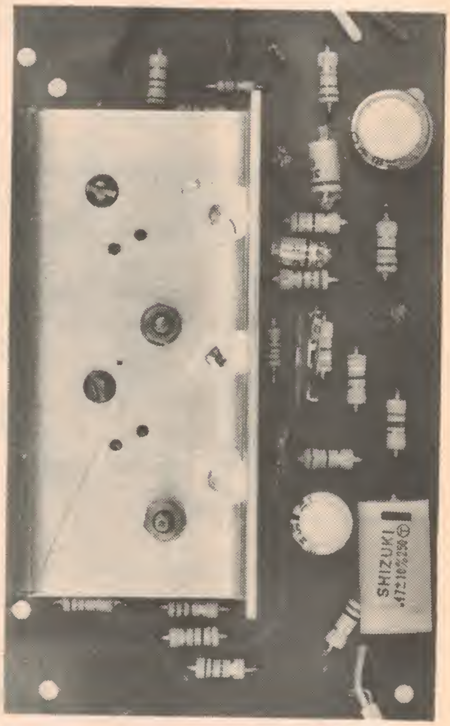
It simply means that the modules can now be built without electrical modification from a range of transistors — Fairchild and otherwise — according to what is available and suitably priced.

Fairchild themselves have suggested imported alternatives to the original Australian made types. Instead of the AY8171 they suggest the 2N4232; for the AY9171 substitute the 2N3740.

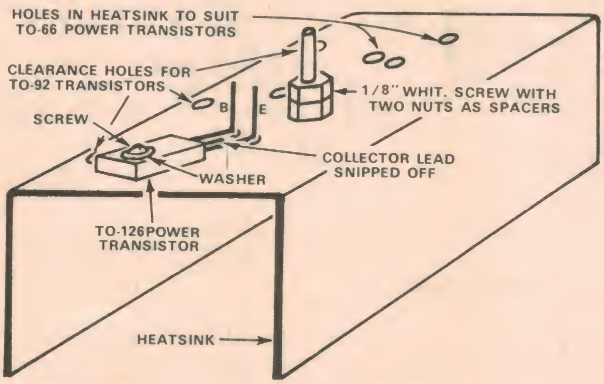
Most of the alternative transistors which warrant consideration, come in an SOT-32 plastic encapsulation. They can be regarded as a direct electrical replacement for the earlier TO-66 style transistors, but are mechanically quite different. Fortunately, it has proved possible to retain the same circuit board and heatsink, varying only the method of assembly.

It is still possible to obtain the Fairchild small-signal transistors, but we have specified possible replacements for these types as well. The complete set of possible replacements is listed in the accompanying table. Where there are two or more types of the same brand listed, the first listing is the preferred choice, although the remaining types will work satisfactorily.

It is possible to mix brands without any loss in performance; for example Fairchild small-signal transistors may be used in conjunction with Philips power transistors, &c.



Shown above is a completed power module using the new plastic power transistors. The silicon grease surrounding the TO-92 driver transistors can be seen.



The exact method of mounting the plastic transistors is apparent from the three dimensional sketch at left.

Below: A view of the way in which the power transistor leads are bent is shown in the larger-than-life photograph. Do not allow the leads to touch the heatsink.

The reader is referred to the accompanying sketch for full details of the method used to mount the plastic encapsulated transistors. Care should be taken that the following points are observed while fitting them.

The power transistors are fitted underneath the heatsink, and bolted to it through the holes provided to mount the TO-66 type transistors. They must be mounted with the metal part next to the heatsink, as this forms the collector connection. As a result of this, the collector lead provided can be carefully snipped off close to the body of the transistor. (The collector lead is the centre one).

To ensure that the base and emitter leads

are not transposed, it is vital that the mounting hole furthest from the original centre clearance holes be used in each case to mount the plastic transistors. On the heatsink, these happen to be the holes nearest to the dimples for the driver transistors. The transistors are secured to the heatsink using suitable nuts and bolts. A small washer should be used under the head of the bolt, as shown in the diagram, and silicon grease applied to ensure good thermal contact between the transistors and heatsink.

Do not use excessive force when tightening the nuts, as this may damage the transistors. Take particular care that the actual transistors are not interchanged. The heads of the bolts must be on the underside of the heatsink to ensure that the transistor leads are long enough to reach through to the copper pattern on the board.

Once the transistors have been fixed to the heatsink, their base and emitter leads may be bent as shown in the diagram. Use the holes in the heatsink as a guide, and hold the leads next to the body with a pair of small long nosed pliers to prevent them from breaking off.

The heatsink is held in position, and the collector connection made by bolts through the remaining holes. We used two nuts as spacers to position the heatsink a suitable distance from the board. Do not forget to tin the copper pattern underneath the nuts to provide good electrical contact.

No difficulties should be experienced with the mounting of the small-signal transistors, as all the recommended types have TO-92 cases like the Fairchild types. These TO-92 versions mount partly through the heatsink; drill directly above where the transistors will mount with a suitable sized drill so that they are a snug fit. Do not solder them to the board until the heatsink has been fixed in position, as otherwise their height may be wrong. The final step is to thermally bond their cases to the heatsink with a [illegible]

Displays two signals at once:

An electronic Scope Switch

by LEO SIMPSON

With this Scope Switch you can extend the capability of your oscilloscope to dual trace operation. This enables two independent signals to be observed on a single-beam instrument, so that comparisons between them are easily made.

As an aid for observing, measuring and analysing electrical signals, the cathode ray oscilloscope is unparalleled. But the conventional single-beam oscilloscope used in the normal way can only monitor one signal at a time.

Where two or more signals must be monitored simultaneously the single beam instrument can still be used in many cases, but the operator needs more skill in interpreting the resultant display. For example, phase and frequency differences between two signals may be measured using the technique known as "Lissajous Figures." This involves feeding the two signals to the horizontal and vertical amplifiers of the oscilloscope. Almost every standard electronics textbook has illustrations of the characteristic patterns produced by this method.

There are quite a few other methods whereby a single beam oscilloscope can be used to compare different signals but they too require further skill on the part of the operator.

By far the easiest way to monitor two signals simultaneously is to view them on a dual trace oscilloscope. Note the term "dual trace" rather than "dual beam." There are comparatively few true double beam oscilloscopes available and they are very expensive. In the dual trace oscilloscope, a single gun CRT is employed and the beam is switched rapidly between two signals to give two traces which sweep across the tube face at the same speed.

This modern oscilloscope has both chopped and alternate dual trace display.

We shall describe how the beam is switched between the two signals as the article progresses. Essentially, what our Scope Switch does is to convert a normal single beam (or single trace) oscilloscope to dual-trace operation. This greatly extends the measurement capability of the instrument.

For example, when testing an amplifier one can compare input and output signals and note any phase shifts or distortion. When testing a stereo amplifier, comparisons can be made of signals in both channels, and crosstalk between channels can be observed directly.

One might also use a dual trace oscilloscope for checking a transmitter — comparing the modulation envelope with the modulation signal. Alternatively one can observe demodulation in a radio receiver.

In digital circuitry, the dual trace oscilloscope really becomes indispensable for observing the timing relationships between different pulse trains, and seeing logic at work!

Now there are actually two modes of operation by which a dual trace display can be produced in a single beam oscilloscope. One is the "chopped" mode, the other is the "alternate" mode. In the chopped mode, the electron beam is switched rapidly between the two signals at a rate considerably higher than the frequency of the signals being observed.

In effect, what happens is that a square wave of high frequency is applied to the vertical amplifier of the oscilloscope. At the same time, the signals to be displayed are superimposed on the square wave — one signal on the upper part of the waveform and other signal on the lower part of the waveform. The vertical sections of the waveform become invisible, provided the rise and fall times of the square wave are rapid enough.

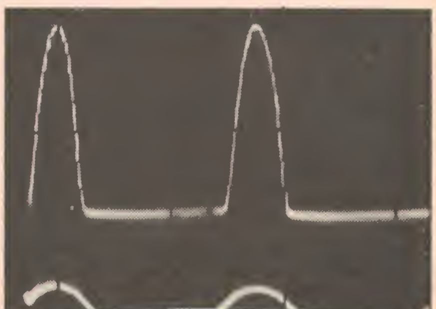
The "chopped up" nature of the two apparent traces seems to disappear for two reasons. One is that each waveform develops visual continuity due to its "row of little dashes" nature. The other is that the switching frequency of the square wave is

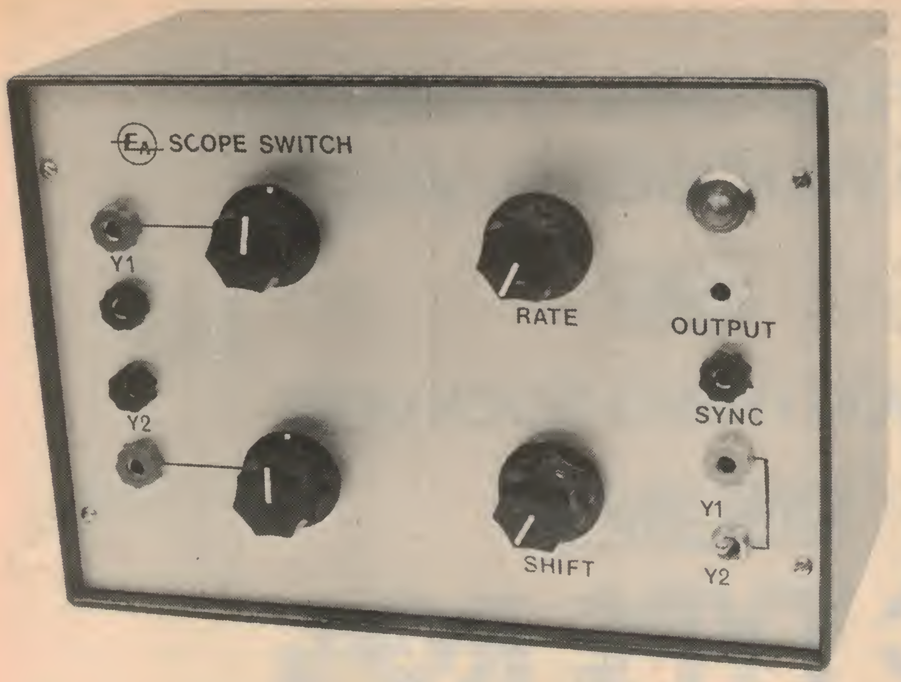
half of the square wave (and one signal) in one complete sweep and the lower half of the square wave (with the other signal) on the successive sweep. Hence the "alternate" operation. Thus, in this mode the two traces are produced successively, and persistence effects in the tube phosphor and the human eyes make it seem as though there are two separate and simultaneous traces.

Most dual trace oscilloscopes have both chopped and alternate trace operation and the mode is automatically selected by the timebase switch (chopped for low speeds, alternate for high). On the more flexible instruments the user has the option of selecting the mode of operation himself. So that we could keep the circuit as simple as possible, our Scope Switch provides the chopped mode only.

Refer now to the circuit. Six transistors and two diodes are used in the basic circuit. Transistors Tr1 and Tr2 form a free-running multivibrator producing a square wave at approximately 40kHz. Diodes D5 and D6 plus associated resistors are added to improve the "turn-off" times of the transistors.

Transistors Tr3, Tr4, Tr5 and Tr6 form two separate direct coupled amplifiers with a common output load, a 2.2k resistor. Input signal levels (Y1 and Y2) to the two amplifiers may be adjusted independently by the appropriate 100k potentiometer. The





multivibrator chops the output between the two input signals by alternately switching off Tr4 and Tr6. It does this by "pulling" the emitter (of Tr4 or Tr6) below the base potential, via the 2.7k resistors connected to the collectors of Tr1 and Tr2.

Although the two DC amplifiers (formed by Tr3, 4, 5 and 6) have a common 2.2k output load, they virtually operate independently by virtue of the fact that they are alternately switched out of operation. This means that they can have different DC output levels, which is essential if the two traces are not to be superimposed one on top of the other. Accordingly, the 25k potentiometer adjusts the DC output levels by setting the bias levels of Tr3 and Tr5.

Thus, the 25k potentiometer determines the separation between the two traces.

Since it is important that the multivibrator switching frequency not be an exact multiple of the signals Y1 and Y2, an adjustment is provided to vary the frequency. This is labelled the "Rate" potentiometer and it varies the frequency without varying the mark-space ratio or duty cycle of the square wave.

To obtain the best square wave, transistors Tr1 and Tr2 must be NPN silicon types specially intended for switching applications, such as the 2N3643. Similarly, Tr4 and Tr6 must be PNP silicon switching types such as the 2N3638 or direct equivalents. General purpose transistors such as BC108 and BC158 are not really suitable but could be pressed into service if the need warranted.

Transistors Tr3 and Tr5 should be high gain types such as BC109 to maintain input impedance as high as possible. Overall gain of each of the DC amplifiers is set at two.

When viewing the signals, the oscilloscope timebase frequency must be synchronised directly from one of the two input signals — the one desired to be kept stationary. The oscilloscope is accordingly

PARTS LIST

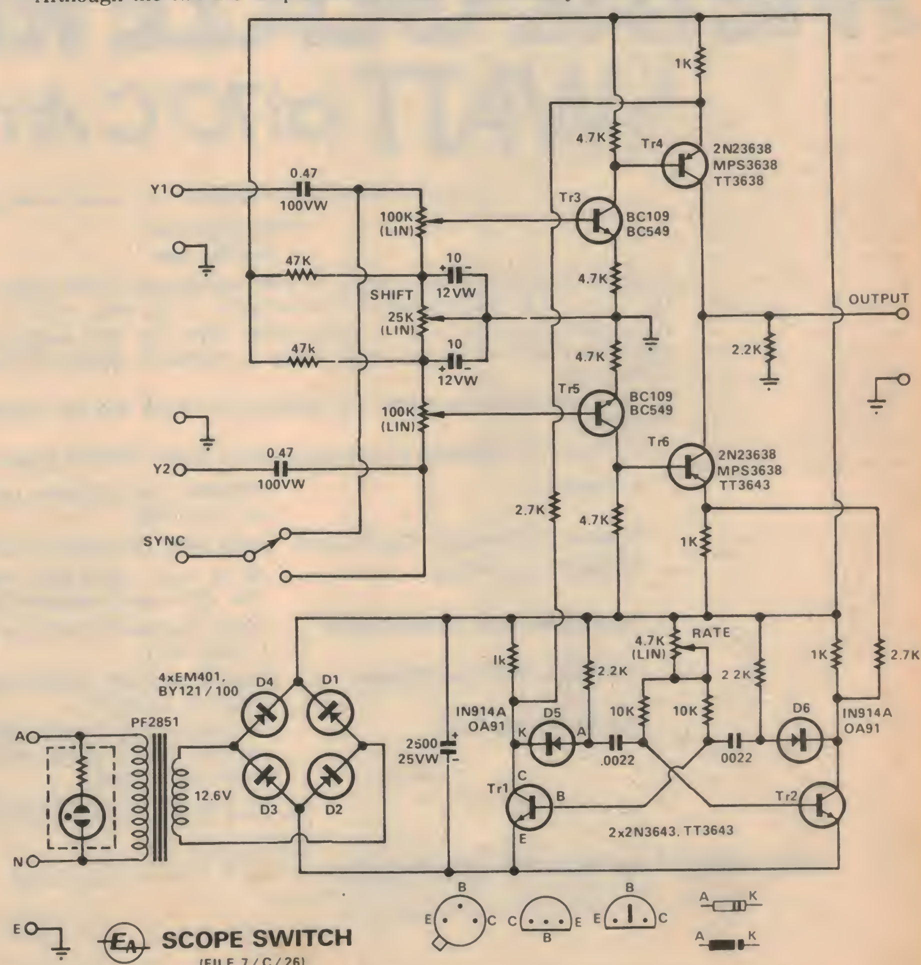
1 ATC instrument case, 178 x 127 x 102mm.
1 miniature power transformer, Ferguson. PF2851 or equivalent.
7 banana plug sockets (4mm), in assorted colours.
1 neon pilot bezel with incorporated limiting resistor.
1 miniature SPDT toggle switch.
1 aluminium sub-chassis (see text and photos)
1 Veroboard, 160mm x 65mm, 0.15in conductor spacing
1 2-way insulated terminal block
1 3-way tagstrip
4 knobs

SEMICONDUCTORS
2 BC109, BC549 high-gain silicon NPN transistors
2 2N3643, TT3643, PN3643 silicon NPN transistors
2 2N3638, TT3638, PN3638, MPS 3638 silicon PNP transistors
2 OA91 germanium diodes or 1N914A, 1N4148 silicon diodes
4 EM401, BY126/100 silicon rectifier diodes.

RESISTORS
(¼W or ½W, 5pc tolerance)
2 x 47k, 2 x 10k, 4 x 4.7k, 2 x 2.7k, 3 x 2.2k, 4 x 1k.
2 x 100k (lin) potentiometers
1 x 25k (lin) potentiometer
1 x 4.7k (lin) potentiometer

CAPACITORS
1 x 2500uF/25VW electrolytic capacitor
2 x 10uF/10VW electrolytic
2 x .47uF/100VW polyester (see text)
2 x .0022uF/100VW polyester or polystyrene

MISCELLANEOUS
Mains cord and three-pin plug, cord-clamp, grommet, solder lug, hook-up wire, solder, screws, nuts, lock-washers.



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SCOPE SWITCH

set for external synchronisation of the timebase (Ext Sync) and the external sync terminal connected to the sync terminal on the Scope Switch. A SPDT toggle switch then selects either Y1 or Y2 for sync.

Batteries may be used to power the unit. Current drain is approximately 40 milliamps with an 18V supply. However, we have provided a mains supply. A miniature transformer providing 12.6V AC is fed to a bridge rectifier and the output is filtered by a 2500uF/25VW electrolytic capacitor to provide 18V DC.

Construction of the unit is fairly straightforward and layout is non-critical provided leads are kept reasonably short. The prototype was housed in a vinyl-covered steel case measuring 178 x 127 x 102mm made by Australian Transistor Company. It is available from all major electronic parts suppliers.

A major portion of the circuitry is accommodated on a piece of Veroboard 160mm long by 65mm wide and with a conductor spacing of 0.15in. Any remaining components are wired between the potentiometers on the front panel. Details are shown in the wiring diagram.

The circuit board is mounted parallel with the front panel by a U-shaped sub-chassis secured to the front panel by the potentiometer nuts. The photographs show the general concept. The chassis can be bent from a piece of light-gauge aluminium or tinplate.

Note that the signal input coupling capacitors have a rating of 100 volts. If it is envisaged that the Scope Switch will be used to monitor valve circuitry with working voltages much higher than this, the voltage rating on the input capacitors will have to be 400 volts or more.

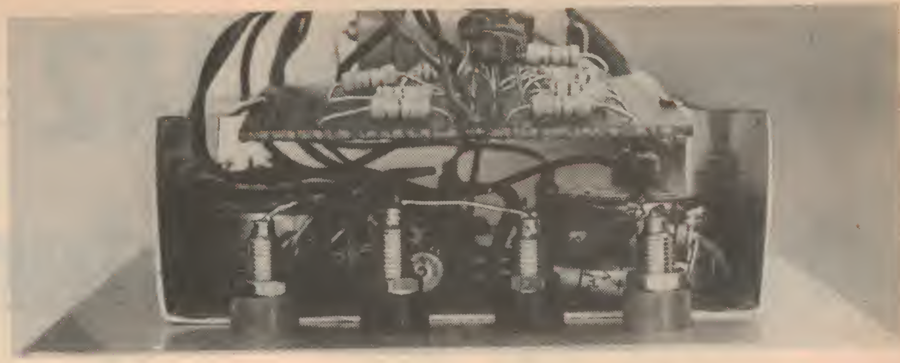
A neon bezel incorporating a current limiting resistor is used, a pilot light running directly from the 240VAC.

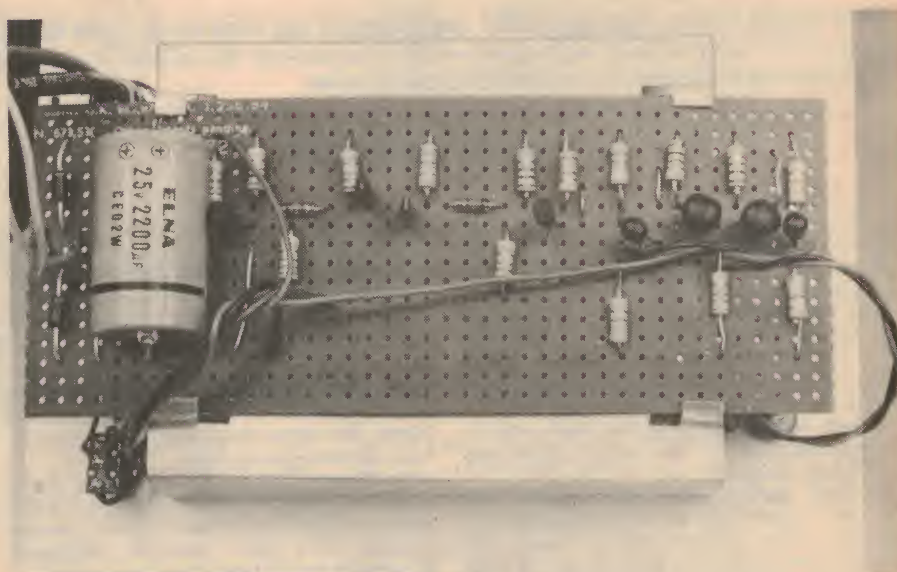
The miniature power transformer, Ferguson PF2851 or A&R 6474 is mounted on the rear panel along with a three-way tagstrip accommodating the low voltage winding connections. The mains active and neutral connections are made via an insulated terminal block while the earth wire is terminated to a solder lug on the rear panel.

Labelling on the satin-finish aluminium front panel is easily accomplished with a sheet of Letraset rub-on lettering which is available from most stationery suppliers. After lettering is complete, give the panel a coat of clear lacquer from an aerosol can to protect it.

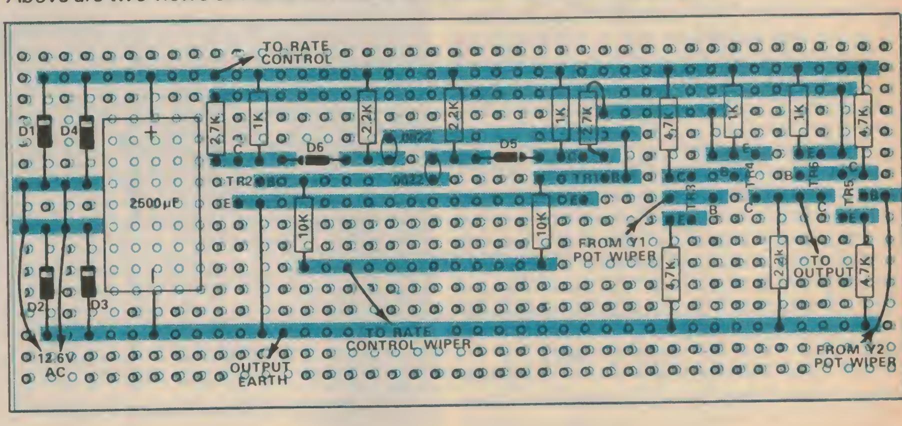
When an oscilloscope is used with the Scope Switch it should be set for AC coupling so that changes of the "Separation" control do not deflect the display off the screen. Set the Separation control so that the two waveforms can be easily viewed. If there is any tendency for the switching pattern of the Scope Switch to synchronise with the displayed waveforms, vary the Rate control to correct it.

Do not set the oscilloscope at too high a brilliance otherwise the waveforms tend to have an obvious "halo" caused by the switching transients of the Scope Switch. With the brilliance set for normal viewing this halo effect is not obtrusive, considering the simplicity of the circuit.





Above are two views of the circuit board while below is the wiring diagram.



At right, a view inside the rear panel showing the small transformer.

Playmaster 142 low cost IC stereo

As a sequel to the Playmaster 141 presented in the June issue, here is the design of an economical, high-quality cabinet version of the amplifier, capable of delivering more than five watts RMS per channel.

by DAVID EDWARDS

The basis of this amplifier is again the Texas Instruments audio power IC, the SN76023, in conjunction with the EA 74/sa5 printed circuit board as used in the Playmaster 141. This board is similar to that used in the Playmaster 137, and in fact the new amplifier is intended to fulfil much the same role as the 137. It is an inexpensive, high quality amplifier of modest output suitable for use with a ceramic cartridge, a tuner or a modern tape recorder or deck.

We have used the same chassis as the 137, and as a result most of the components are similar. This means that it would be possible to replace the board in a 137 with the new board with very little effort, should this be desired.

The SN76023 is in a modified 16 pin dual-in-line plastic package, and is fitted with an integral fan-shaped heatsink. It is available from Kitsets Australia Pty Ltd, the local distributors for Texas Instruments' semiconductors.

Unlike the 137, we have not combined the balance control with the on/off switch. Instead, we have repositioned the balance control near the volume control, as this gives a more logical layout of the printed circuit, and we have provided a separate toggle switch to provide the on/off function. This means that there is less chance of hum pickup, as the 240VAC wiring can be kept away from the input circuitry.

A 3-pole 3-position rotary switch is used to select the input to the amplifier. One position selects ceramic cartridge, another an auxiliary input, while the third gives provision for replay from a tape recorder or tape deck. This connection is made via a standard 5-pin DIN connection cord. Most modern tape recorders and tape decks have this facility. Provision has also been made to enable recordings to be made from either records or the auxiliary input.

This has been done by connecting the outputs of the amplifier to the tape DIN socket. Because of the configuration of the circuit used, it was not possible to take the signal from the usual point in the circuit, which is before the balance and tone controls. This is because the SN76023 is used in a configuration similar to that of an operational amplifier — with feedback, incorporating the bass and treble controls, applied from the output to the input directly.

As a result of this, we were forced to use the same signal as is fed to the speakers. This means that while any recording is taking place, the tone controls must be set at the flat positions, and all the controls left in the positions occupied at the beginning of recording. In particular, the volume control must not be altered during recordings. We have provided trimpots to attenuate the recording signal so that at normal listening levels, the signal level is suitable for the tape machine being used.

We have relied on the switching in the machine to reject the output signal of the amplifier during playback. This is a normal function of a tape machine, necessary to prevent oscillations from occurring.

the amplifier, while the speaker and DIN sockets are located on the rear panel.

The transformer we have elected to use is one of the new low height range made by Ferguson. The recommended voltage for the SN76023 is specified as 28V maximum. Theoretically a 20VRMS transformer coupled to a full wave silicon bridge rectifier would give a no-load voltage of 27.1 volts, allowing for a 1.2 volt drop in the bridge, which would be within the allowable limits for the SN76023. Unfortunately, due to the rather poor regulation of the low-profile transformers, such an arrangement gives a much higher no-load voltage. As a result, we found it necessary to use a lower voltage transformer.

Our choice was the PF3598 transformer, which has two 9 volt secondaries, rated at 1.1 amps each. We connected these in series, to give an 18 volt 1.1 amp rating. This gave us a no-load voltage of 26.5 volts, although due to the poor regulation the full load voltage drops to 21 volts. These values are within the limits of the SN76023, but the

The neat, clean styling of the prototype is illustrated in the photograph directly above, whilst the full circuit details are shown on the facing page.

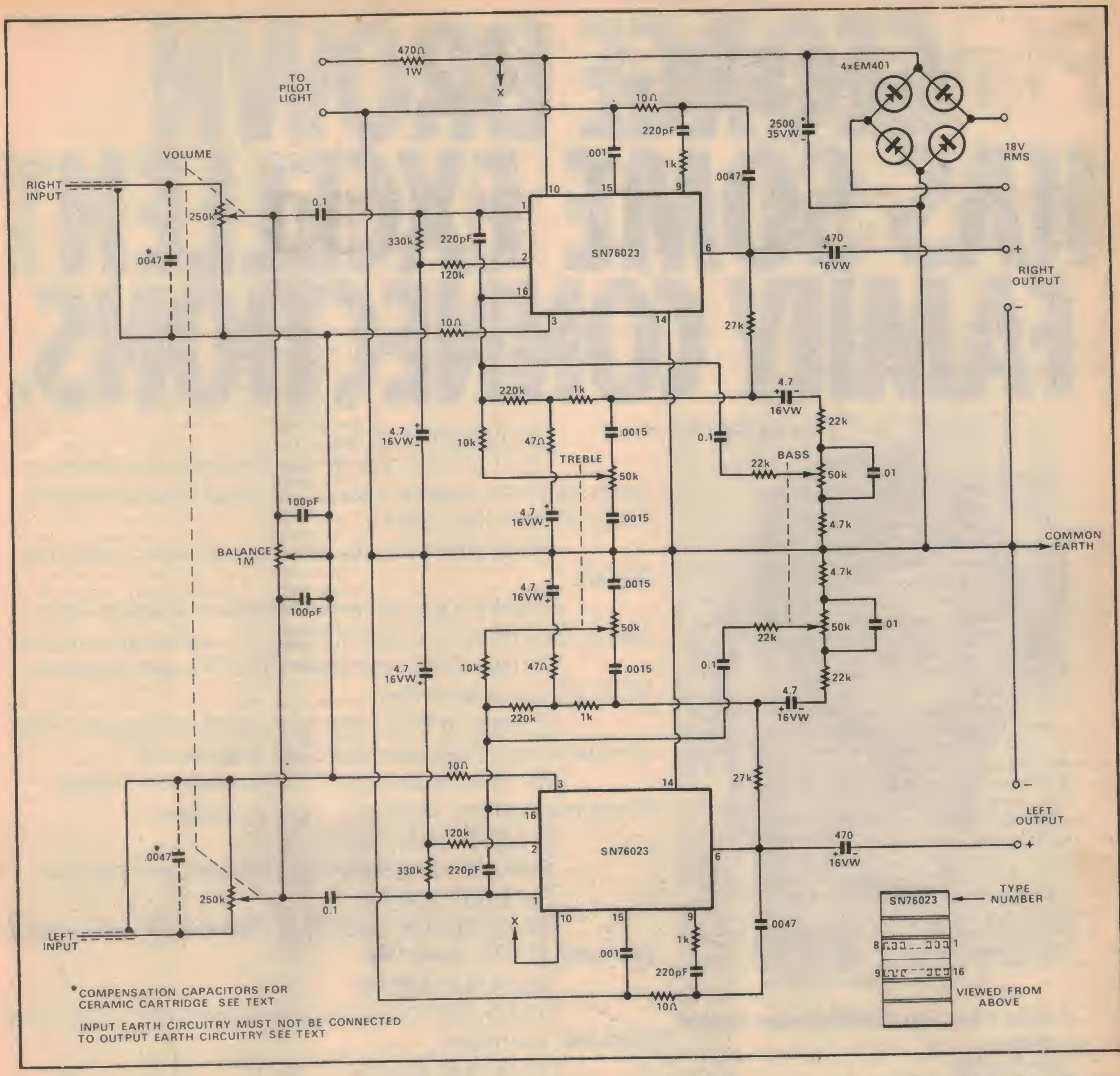
low full load voltage does limit the power available. However the power produced with this transformer should be found quite sufficient for most purposes. A practical listening test in a normal home environment proved this point.

A larger transformer with better regulation could be substituted, but care must be exercised that under no circumstances does the voltage applied to the SN76023 exceed 28 volts, the recommended maximum.

Another facility that we have provided is a headphone socket. This has been wired so that the speakers are automatically disconnected when a pair of headphones are plugged in. Attenuating resistors are used so that the sound level in the headphones is subjectively the same as that of the speakers. A further bonus is that the signal is fed to the tape recorder when the headphones are used, so that if it is required to record without using the speakers, it is a simple matter to plug in the headphones or a dummy plug.

The headphone socket, power switch and pilot light are located on the front panel of

The cabinet we have used is a stock metal case, measuring 121 x 210 x 82.5 mm. This is the same as was used in the Playmaster 137,



and should be available from the usual suppliers.

On the circuit board, we have made provision for two filter capacitors. However, we found that a single 2500uF unit gave acceptable performance. Some improvement to the peak power performance could be expected if a second such capacitor was used also, but this would be the only improvement, and a minor one at that.

In order to avoid the possibility of mains hum being injected into the input circuitry, we have supplied the pilot light with DC, obtained from the filter capacitor using a 470 ohm one watt dropping resistor. This has been mounted on the circuit board near the filter capacitor.

The amplifier is suitable for use only with ceramic or crystal cartridges. Provision has been made on the circuit board to mount the required compensation capacitors, but as the amplifier will be used with other input sources, we have mounted these capacitors on the back of the DIN plug used to connect the cartridge input. An alternative mounting position would be on the tagstrip of the turntable where the leads from the cartridge are terminated.

The internal circuitry of the SN76023 is quite different from that employed in the SL403D as used in the Playmaster 137. The internal circuitry of the SN76023 consists of a differential amplifier, a constant current source and a power amplifier. The DC quiescent conditions are set up by the constant current source using an external resistor combination, with the output of the differential amplifier forming the input to the power amplifier.

This configuration is similar to that used in operational amplifiers, so that the external circuitry is also similar to that used with operational amplifiers. The input signal is applied to pin 1, the non-inverting input, and a feedback signal, frequency compensated by the tone control circuitry, is applied to the inverting input, pin 16. Input and output compensation is applied to pins 15 and 9 respectively.

Pin 2 provides a reference voltage, which is coupled to pin 1 to set the quiescent voltage at the output (pin 6).

There are two earths on the SN76023. Pin 3 is the input earth and pin 14 is the output earth. In order that the circuit is stable, it is necessary that these earths be electrically separated. This has been done on the printed circuit board, and in order to obtain maximum performance, the wiring instructions should be strictly followed.

The SN76023 is recommended for use with 8-ohm speakers. Higher impedance speakers may be used, but with a consequent loss of power output. Speakers with an impedance of less than 8 ohms must not be used, as damage to the output transistors may result.

No automatic overload protection is incorporated in the SN76023, but the massive design of the output transistors and the use of the large heatsink is claimed to give the device a life of greater than 10 years under normal use. A continuous output power of 5 watts RMS is claimed over a temperature range from 0 to 70 degrees Celsius.

PLAYMASTER 142

SPECIFICATIONS

Power: 4 watts music power per channel into 8 ohm loads with one channel driven; 3.1 watts (continuous) per channel into 8 ohm loads with both channels driven simultaneously. 4 ohm loads must not be used.

Distortion: 0.3 per cent THD at ikHz at 3 watts; 0.5 per cent THD at 1kHz at 0.5 watts.

Signal-to-noise ratio: Better than –56dB with respect to 3 watts into 8 ohm loads.

Channel separation: Better than –45dB at 1kHz at 3 watts.

Frequency response: 40Hz to 45kHz, +0dB –3dB (with tone controls set for flat response).

Tone controls: Bass control, 10dB boost and 8dB cut at 100Hz; treble control, 4dB boost and 8dB cut at 10kHz.

Input sensitivity: 55mV for all inputs to produce 3.1 watts power output.

Input impedance: Greater than 100k.

The first step in the construction of the amplifier is to carefully inspect the printed circuit board for any possible faults, such as insufficient etching of the copper. Any shorts between adjacent connections should be carefully removed with a sharp razor blade or similar tool.

The three straps on the top of the board can now be placed in position. We made them out of short scrap lengths of 22 gauge wire. Cut-off component leads make a good substitute, as well as being inexpensive. There is no need to insulate these connections, as there is no danger of short circuits occurring.

The next step is to prepare the components for mounting on the board. The resistors and smaller capacitors should be mounted first, followed by the larger capacitors. The rectifier diodes and the integrated circuits should be the last components to be mounted, as these are most likely to suffer damage during this process.

All the resistors should have their leads bent at right-angles to their bodies, with the exception of the 470 ohm 1 watt resistor, which should be mounted standing on its end. Care must be exercised during this process, as some of the resistors have a longer distance between their mounting holes than others.

After all the resistors have been mounted on the board, a check should be made to ensure that there are no errors. Once this has been done, the smaller capacitors can be mounted on the board. Care should be taken that the electrolytics are mounted with the correct polarity. The large electrolytic filter capacitors may be left off the board at this stage, as they tend to obscure some of the smaller components.

The four rectifier diodes can now be fitted to the board. Before doing so, bend their leads around in complete loops. This will prevent mechanical and thermal stresses from causing the diodes to fail prematurely. Details of this are shown in the photograph. The diodes must be mounted with the correct polarity — details are shown in the printed circuit board layout diagram.

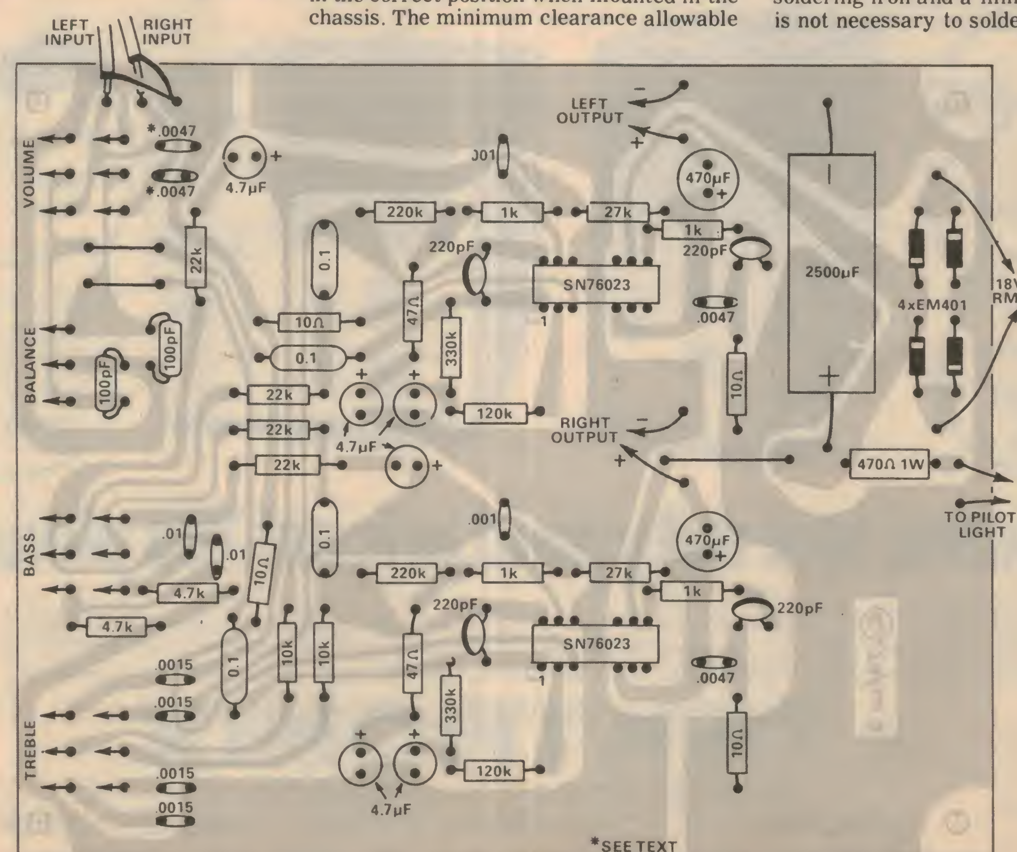
Before proceeding to fit the potentiometers to the board, cut the shafts to the correct length, allowing for the knobs to be used. At this stage, the shaft of the selector switch can also be trimmed to the correct length.

The next stage of the assembly is to mount the potentiometers onto the board. Cut 21 40mm lengths of 22 B & S gauge tinned copper wire, and solder these to the potentiometer lugs. These form the connections to the board. They must be suitably bent and cut to length so that the board sits in the correct position when mounted in the chassis. The minimum clearance allowable underneath the board is 5mm.

Suitable lengths of colour coded hookup wire can now be soldered to the board in the positions shown on the wiring diagram. Use the leads supplied with the transformer to make the connections to it, as these come with insulated sockets to suit the pins on the transformer. A 60mm piece of twin shielded cable must be soldered to the audio inputs of the board, to connect to the selector switch.

A short piece of copper braid should be soldered to the copper of the pattern near the speaker earth for the left channel. Once this has been done, the integrated circuits can be fitted to the board.

The SN76023 has its type number and the "Texas Instruments" trade mark printed on the top of the heatsink fin nearest to pin 1. It must be mounted so that this pin corresponds to pin 1 on the circuit board, which is marked with a "1" on the copper pattern. Do not mount the SN76023s using integrated circuit mounting sockets, as these tend to cause a deterioration in performance and stability. Solder them directly to the circuit board, using a hot soldering iron and a minimum of solder. It is not necessary to solder those pins which



The component overlay on the printed board. Take care to ensure correct orientation of polarised components.

PLAYMASTER 142

are not connected to the circuit (pins 7, 8 and 11).

The electrolytic filter capacitor can now be added to the board, ensuring that the correct polarity is observed. The board should now be thoroughly checked to ensure that all components have been fitted in the correct place and with the correct polarity. This is important, as a mistake could lead to failure of the SN76023s.

We have now arrived at the stage where the main components can be fitted into the chassis. The power transformer is mounted on the left-hand side, and screwed to the base with machine screws and nuts. A solder lug is fitted to the mounting lug as shown in the photograph. This forms the main earth point of the amplifier.

The mains cord enters the chassis through a grommeted hole in the rear left-hand corner. It is terminated at a 3-terminal block mounted in front of the transformer. Do not omit the cord clamp used to anchor the cord, as otherwise a sharp lug on the cord could cause a possible shock hazard.

The active and neutral wires are terminated at the terminal block, while the earth wire is soldered to the solder lug. A wire is run from the active terminal to the on-off switch, through an in-line fuse, and back to the remaining terminal of the terminal block. The transformer is wired between this terminal and the neutral terminal.

The two 1K trim-pots can be soldered to the six-lug tag strip, taking care that when they are mounted in the chassis they are easily accessible for adjustment.

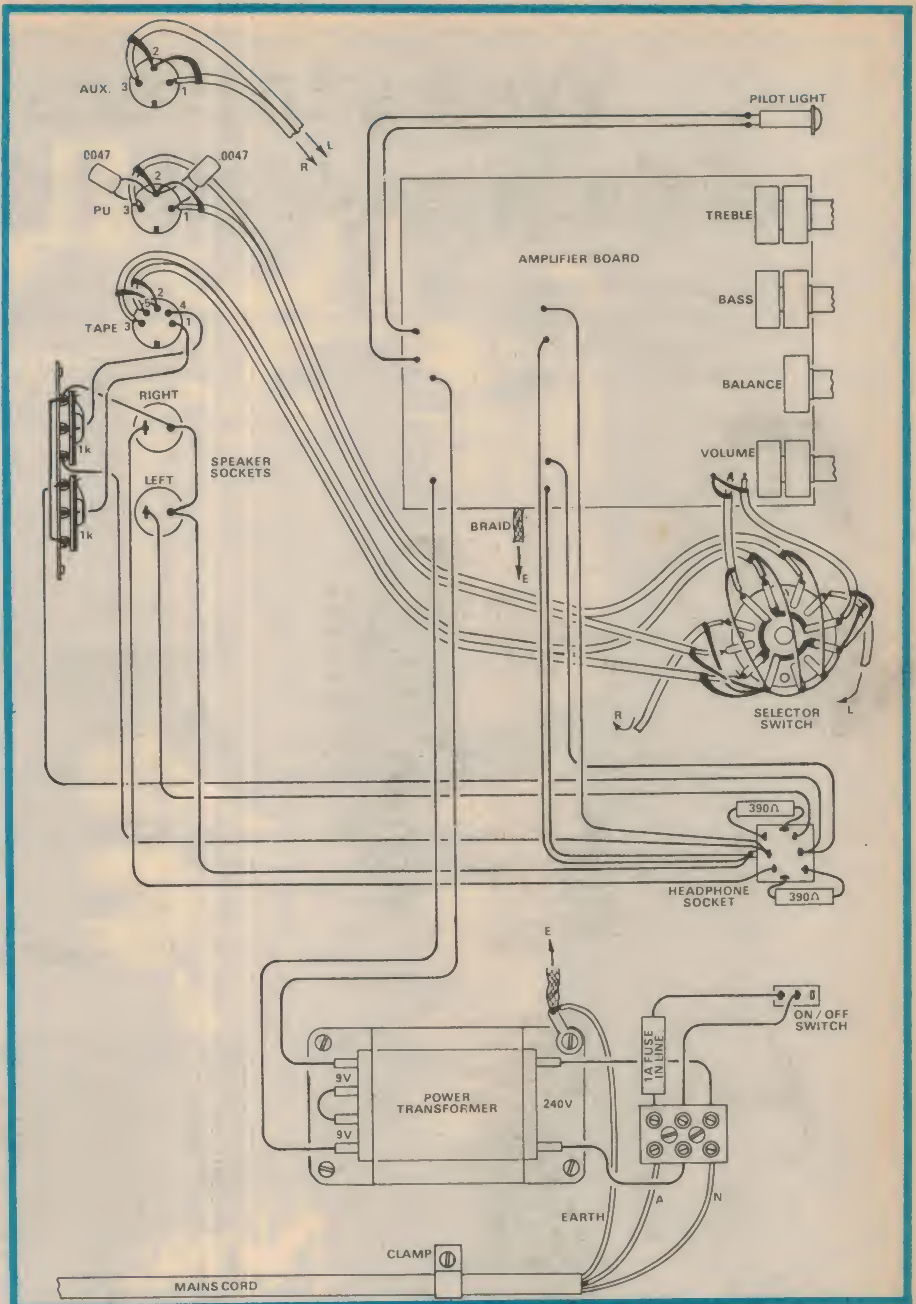
The three DIN sockets can now be mounted on the rear panel of the amplifier, along with the two polarised speaker sockets. The tag strip can also be attached to the rear panel at this stage. These components are all mounted using suitable machine screws and nuts. Alternatively, "pop rivets" may be used, if available.

The finished printed circuit board can now be mounted in the chassis. It is supported at the front by the potentiometer shafts passing through the front panel, and at the rear by two machine screws, using nuts as spacers. As the clearance underneath the board is not very great, it is advisable to line the portion of the chassis underneath the board with cardboard, to prevent possible short circuits.

The wiring to the transformer can now be completed. The wires from the board connect to the two outside pins, while the two inside pins connect together with the short wire supplied with the transformer. The copper braid which forms the earth connection can be soldered to the lug attached to the chassis by the transformer mounting bolt.

The speaker wiring can now be completed. Solder the two 390 ohm resistors to the headphone socket in their correct positions, as shown in the wiring diagram. Next connect the speaker wires from the circuit board to the socket, taking care that the channels are not transposed and that the two earth wires are connected to the correct lugs.

The five wires required to connect to the DIN sockets and the tag strip at the rear of the case can now be soldered to their



This diagram shows details of the input and switch wiring and the power supply, headphone and speaker connections. Take care to ensure the correct earth wiring sequence.

respective lugs. The wiring diagram gives details of which lugs to use. To avoid the possibility of mistakes, it is best to use coloured wires.

The wiring at the rear of the case can now be completed. The wiring diagram should be strictly followed, particularly in regards to the wiring to the tape DIN socket. Do not make a connection to the earth of the DIN socket from the speaker earth, as this may cause hum pickup and instability. The earth connection for the tape socket is via the shielded cable to the input selector switch.

Before the selector switch is fitted, one pole of the connections should be shorted out. This will provide a common tie point for all the shields of the input cables.

The switch can now be fitted to the chassis. The locating lug matches with the small hole underneath the 9.5mm (3/8in) mounting hole. Using twin shielded cable, the connections to the circuit board can be made. At the circuit board, both shields are connected together and then soldered to the board. At the switch, the shields are also connected together, and are soldered to the four commoned terminals of the switch.

The shielded cables for the auxiliary inputs, the tape inputs and the pick-up inputs can also be connected to the switch. The shields of all these cables are connected to the for commoned terminals of the switch also.

The other ends of these shielded cables can now be connected to the respective DIN sockets at the rear of the chassis. Before attaching the pick-up cable, solder the two 4700pF compensation capacitors across the socket, between pins 1 and 2 and pins 3 and 2. The inner conductors are then connected to pins 1 and 3, and the shields are connected to pin 2. Again do not connect between pin 2 and the metal shield of the

socket, as this will make a connection between the input and output earths, and may cause instability problems.

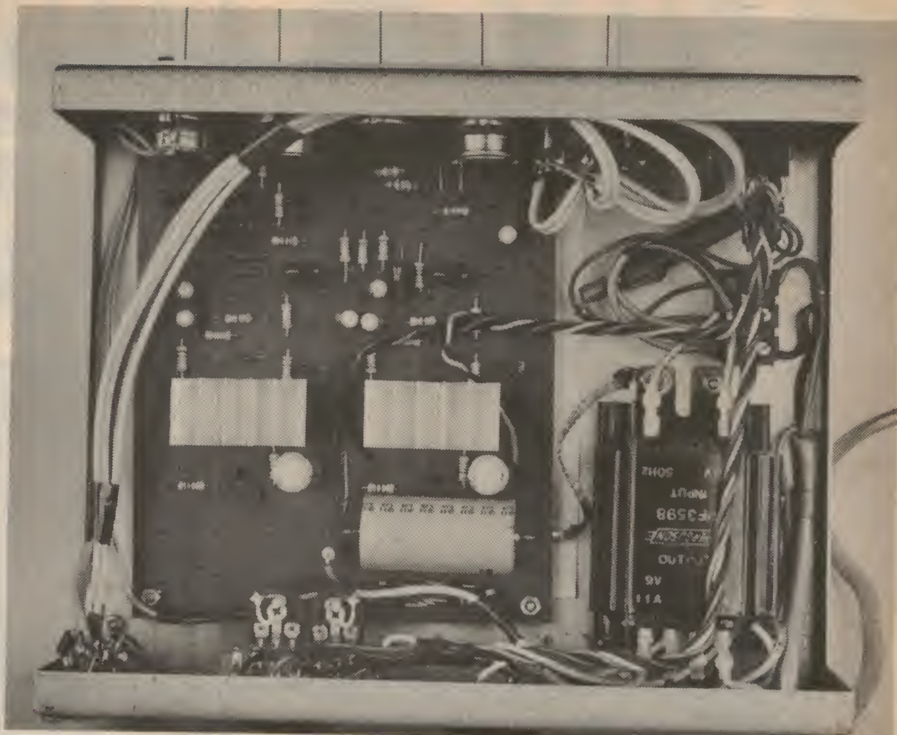
The auxiliary socket is wired in exactly the same way as the pick-up socket, excepting that the compensation capacitors are not required. The tape socket is wired with the shielded cables from the selector switch soldered to pins 3 and 4. The shields are connected to pin 2, which must not be joined to the chassis.

When wiring up the DIN sockets, take care that the left and right channels are connected to the correct pins, as detailed on the wiring diagram. Incorrect connections will result in confusion between the left and right channels.

The final constructional step is to complete the wiring to the pilot light, and to fit the headphone socket and the on / off switch to the front panel, if this has not been done. Make sure that the on / off switch is mounted so that the up position is off, so as to follow the normal conventions. The orientation of the headphone socket is not critical.

Before attempting to test the amplifier, carefully check all connections, particularly those associated with the 240V wiring, as a mistake could have serious consequences. Do not at this stage fit the cover to the chassis, as the trimpots will have to be adjusted to suit the tape machine.

Connect up a suitable pair of speakers, and feed a suitable signal into either the PU or the AUX input. Set the selector switch to the position to suit. Set the treble, bass and balance controls to their mid positions, and set the volume control fully anti-clockwise.



Inside view of the completed amplifier showing the relative positions of the major components.

Plug the mains cord into a suitable receptacle and switch on the amplifier. The pilot light should light, and a small plop should be audible from the speakers. This is normal. Slowly advance the volume control and check that sound is coming from both speakers. The effect of the bass, treble and balance controls can then be checked.

If no sound can be obtained, check that a signal is being applied to the relevant socket, and that the selector switch is passing the signal to the amplifier.

Once the amplifier is functioning normally, the controls can be set to their normal positions ready to adjust the trimpots. We recommend that the balance, bass and treble controls be set to their mid positions, so as to give a flat response when recording, and to ensure that the channels are balanced. Set the volume control to the normal listening level, and adjust the trimpots to give no signal at the DIN socket. This is done by turning the right hand one fully anti-clockwise and the left hand one fully clockwise.

Using a suitable cord, connect between the tape machine and the amplifier. Turn the selector switch to TAPE, and put the tape machine in the replay mode. The signal from the tape should be reproduced in the speakers.

Next connect a suitable source up to the AUX or PU input, and operate the selector switch to suit. Put the tape machine into the record mode, and set the controls on the tape machine at their normal levels, and the amplifier volume control to produce a convenient listening level. Slowly advance the trimpots so that a suitable strength of signal is obtained. If there are no level indicating devices fitted to the tape machine, advance the trimpots only sufficiently to obtain correct recording.

Once this has been finished, the cover can be placed in position. It must be remembered that the signal strength at the TAPE socket is dependent on the volume control setting, so that during recording the volume should not be adjusted. If it is desired to record without having the sound in the speakers, either a pair of headphones or a dummy plug should be inserted into the headphone socket.

LIST OF COMPONENT PARTS

2 Texas Instruments SN76023 audio amplifier ICs
1 Power transformer 240V primary, 9V + 9V secondary at 1.1A rating. (Ferguson PF3598 or similar)
2 Loudspeaker plugs and sockets with polarised pins
3 5-pin DIN plugs and sockets
1 Circuit board EA 74/sa5 (172 x 140mm)
4 Diodes, EM401 or similar
1 1M linear potentiometer
1 250k log potentiometer (dual gang)
2 50k log potentiometers (dual gang)
1 3-pole 3-position rotary switch (MSP No. AK52253 or similar)
2 1k preset linear potentiometers
5 knobs
1 6-lug tag strip
1 Stereo headphone jack (double pole / double throw)
1 240V toggle switch
1 6V bezel (Ducon "BFB" or similar)
1 In-line fuse holder and 1A fuse
1 10A 3 pin power plug
2 metre 240V flex
1 mains cord clamp
1 3-terminal block
2 metre twin shielded cable
1 Chassis (see text)
1 Front panel (see text)

RESISTORS *(½W 10pc unless specified)*
4 10 ohm
2 47 ohm
1 470 ohm 1 watt
4 1k
2 4.7k
2 10k
4 22k
2 27k
2 120k
2 220k
2 330k
2 390 ohm

CAPACITORS
2 100pF 30VW
4 220pF 30VW
2 1000pF 30VW
4 1500pF 30VW
4 4700pF 30VW
2 .01uF 30VW
4 0.1uF 30VW
6 4.7uF 16VW electrolytics
2 470uF 16VW electrolytics
1 2500uF 35VW electrolytic

MISCELLANEOUS
Hookup wire, solder, solder lugs, screws and nuts, lockwashers, 22 B & S gauge tinned copper wire, copper braid, rubber feet.

Note: resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, providing ratings are not exceeded.

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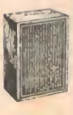
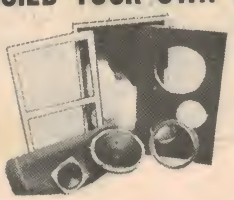


Yes you can build a really professional cabinet with these kits because Dick has done all the complicated carpentry for you. Joints are premitred and all cabinets have a beaut veneer finish. No one will believe you built them, they're that good!! 8ohm speakers. We supply everything including Innerbond, ready for you to start glueing. You can build them in about an hour and just look what you'll save: System 1 is intended for our popular Project 250 amplifier



system. Features a 6" dual cone wide range speaker and FULLY BUILT Cabinet. Just bolt in the speaker and connect up. Handles 12W peak. Measures 15" x 10" x 7". It's a knock out at $17.95 (P&P $2.50).
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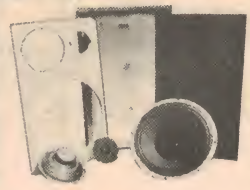

12" heavy duty Bass driver and dome tweeter combination. Fully sealed enclosure uses the acoustic suspension principle. Handles 30W rms with a response from 30 to 30,000Hz. Yes a full 2 way 12" system is yours at a fraction of the normal price for just an hour's fun building it. Terrific value at **$49.99** (P&P Road Freight on).
System 4 as system 3 but has sealed midrange unit also **$57.90** (P&P freight on).
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AC128	.60	.56
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AC132	.60	.56
AC187	.70	.60
AC188	.70	.60
AC187 / 188 Pair	1.40	1.30
AD149 Use OC26		
AD161	1.40	1.30
AD162	1.40	1.30
AD161 / 162 Pair	2.80	2.60
AF114	.90	.85
AF115	.90	.85
AF116	.90	.85
AF117	.90	.85
AF118	1.40	1.30
ASZ15 (OC28)	3.60	3.40
ASZ16 (OC29)	3.65	3.45
ASZ17 (OC35)	3.60	3.40
ASZ18 (OC36)	3.65	3.45

AY8140	1.50	1.40
AY9140	1.50	1.40
AY8171	1.20	1.10
AY9171	1.20	1.10
AY8149	1.20	1.10
AY9149	1.40	1.20
BC107 (BC547)	.25	.22
BC108 (BC548)	.25	.22
BC108B	.45	.40
BC109 (BC549)	.25	.22
BC109C	.45	.40
BC147	.45	.40
BC148	.45	.40
BC149	.45	.40
BC157(BC177)	.30	.26
BC158(BC178)	.30	.26
BC159 (BC179)	.30	.26
BC186	.70	.65
BCY70	.70	.65
BCY71	.85	.80
BCY72	.70	.65
BD137	1.70	1.60
BD138	1.75	1.65
BD137 / 138 Pair	3.40	3.20

BD139	1.50	1.45
BD140	1.60	1.55
BD139 / 140	3.10	3.00
BDY20 Use 2N3055		
BF115	.70	.65
BF167	.65	.60
BF173	.85	.80
BF177 (BF336)	1.50	1.40
BF178 (BF336)	1.50	1.40
BF179 (BF337)	1.60	1.50
BF180	1.20	1.10
BF184	.65	.60
BF185	.65	.60
BF194	.50	.45
BF195	.50	.45
BF200	1.25	1.20
BFW10 Use 2N5459		
BFW11	1.45	1.35
BFW61	1.30	1.20
BFY50 (2N3053)	.80	.70
BFY51	.80	.70
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OC44	.45	.42
OC45	.45	.42
OC70	.40	.36
OC71	.40	.36
OC72	.45	.42
OC74	.45	.42
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2N2646	1.40	1.30

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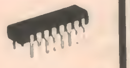
2N3053	.80	.70
2N3054	1.70	1.60
2N3055	1.20	1.00
2N3564	.55	.50
2N3566	.65	.60
2N3567	.65	.60
2N3568	.75	.70
2N3569	.65	.60
2N3638	.45	.40
2N3638A	.55	.50
2N3702	.50	.45
2N3640	.60	.50
2N3641	.45	.40
2N3642	.45	.42
2N3643	.55	.50
2N3644	.45	.40
2N3645	.55	.50
2N4292	.50	.45
40250 Use 2N3054		
40408	2.50	2.40
40409	3.00	2.90
40410	3.00	2.90

IC'S



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SN7402N	.60	.54	.48
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SN7404N	.50	.54	.48
SN7405N	.60	.54	.48
SN7408N	.60	.54	.48
SN7409N	.60	.54	.48
SN7410N	.60	.54	.48
SN7413N	.80	.72	.65
SN7420N	.60	.54	.48
SN7430N	.60	.54	.48
SN7437N	1.20	1.10	1.00
SN7440N	.60	.54	.48
SN7441AN	2.20	2.10	2.00
SN7442N	2.00	1.90	1.80
SN7447N	3.00	2.80	2.60
SN7450N	.60	.54	.48
SN7451N	.60	.54	.48
SN7453N	.60	.54	.48
SN7454N	.60	.54	.48
SN7460N	.60	.54	.48
SN7470N	1.00	.95	.90
SN7472N	1.00	.95	.90
SN7473N	1.20	1.10	1.00
SN7474N	1.20	1.10	1.00
SN7475N	1.50	1.40	1.30
SN7476N	1.20	1.10	1.00
SN7480N	1.80	1.75	1.70
SN7482N	1.90	1.85	1.80
SN7483N	2.45	2.40	2.35
SN7486N	1.20	1.10	1.00
SN7490N	1.25	1.20	1.15
SN7491AN	1.60	1.55	1.50
SN7492N	1.50	1.45	1.40
SN7493N	1.50	1.45	1.40
SN7495N	2.20	2.10	2.00
SN7496N	2.20	2.10	2.00
SN74107N	1.10	1.00	.90
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D22	7 NPN transistors 4 x BC108, 3 x BC109
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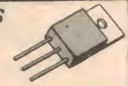

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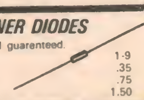

	1-9	10 up
400 MW (BZY88-BZX79 series)	.35	.32
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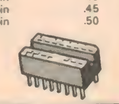

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OA90	.25	.20	.15
OA91	.25	.20	.15
OA95	.25	.20	.15
OA200	.30	.25	.20
OA202	.30	.25	.20
IN4148 (IN914A)	.15	.13	.10

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Vceo — 50V Vcbo — 80V I.C. — 10 amps
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OC 74	.45	.42
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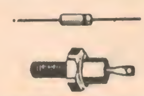
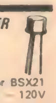
Yes — identical to those that normally sell at $1.80 each.

SILICON RECTIFIERS — Fabulous Value



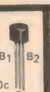
1 Amp (Plastic)	1-9	10-99	100
EM4005 / IN4001 50 Volt	.15	.14	.13
EM401 / IN4002 100 Volt	.20	.19	.18
EM404 / IN4004 400 Volt	.22	.21	.20
EM410 / IN4007 1000 Volt	.36	.34	.30
10 Amp (Stud SO10 Case) — A Bargain			
MR110 100 P.I.V.	.90	.85	.80
MR410 400 P.I.V.	1.20	1.10	1.00

ND120 NIXIE DRIVER TRANSISTOR



Suitable replacement for BSX21 C407 2N1893 etc Vcb — 120V
1-9 **ONLY 60c** 10 up 60c

UT46 UNIJUNCTION TRANSISTOR



Electrically equivalent to 2N2646 etc.

60 CENTS 10 up 50c

ENORMOUSLY RUGGED SCR'S

—Ideal for S.C.R. ignition etc. — TO48 Case.

	1-9	10 up
C164D 400 Volts at 16 Amps	2.75	2.50
C168D 800 Volts et 16 Amps	4.50	4.25

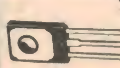
LIGHT EMITTING DIODES

Cheapest in Sydney — Litronix, Texas, Fairchild.

	1-9	10 up
Miniature red	.30	.26
Lge with Mtg, red	.45	.40
Medium green	.90	.80

SILICON CONTROLLED RECTIFIERS

— Bargain prices — all plastic pack G.E



	1-9	10 up
BRY39	1.60	1.50
C103B 200 Volts at 0.8A	1.76	1.56
C106Y1 30 Volts at 4A	1.00	0.95
C106D1 400 Volts at 4A	1.50	1.30
C122D 400 Volts at 8A	2.20	2.00
C122E 500 Volts at 8A	2.70	2.50

2N3055 T03 METAL CAN

Not Plastic

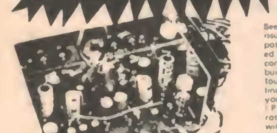
115 Watt Silicon NPN Power — FULLY IMPORTED — best in Australia . and cheapest too!

$1.20 each

ZN414

10 transistor radio IC from Ferranti. Operates from 1.5V. Power Gein 72 db consumes only 300uA. Frequency range from 150kHz to 3MHz. See Elementary Electronics E.A. May '74. **ONLY $3.95**

ONLY $14.95



Project 250, 25W stereo amplifier

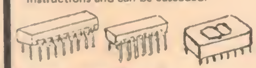
See our ad in June 74 E A or review in May issue. Fully built just add power supply and four pots! Philips and Motorola components. Heatsinked 10 transistor and 4 diode. Preamp and tone control board included. Kit A consists of fully built and tested amplifier and instructions. Add four pots 3 x 50k dual log and 1 x 50k single linear and a power supply of 24-30V at 1A. Yes, you've got a 25W (peak) amplifier for **$14.95** (P & P $1.00). Kit B is as A above but has four rotary pots also. Just add power supply and a few wire links **$19.95** (P & P $1.50). Kit C is as B above but also has components for power supply. Here is a COMPLETE kit for just **$29.95** (P & P $2)

LINEAR INTEGRATED CIRCUITS

TYPE	CASE	DESCRIPTION	1-9	10 up
AWM 1306	TO5	FM Converter	$6.20	$5.80
CA 3028A	TO5	RCA Linear	3.00	2.80
LM 301A (UA 301A)	TO5	High input operational amp.	1.30	1.20
LM 309 (7805)	TO3	5 volt 1 amp regulator	4.20	4.00
LM 308 N	D.I.L.	Operational amp.	4.00	3.60
LM 381	D.I.L.	Dual operational amp	4.50	4.00
LM 709 (see UA709C)				
LM 741 (see UA741C)				
MC 1330P	D.I.L.	Homodyne IC	3.20	3.00
MC 1469R		½ amp voltage regulator	4.75	4.40
NE 555	D.I.L.	Timer IC	2.45	2.20
NE 556	D.I.L.	Duel timer	2.75	2.50
NE 561B	D.I.L.	Phase Lock Loop IC	9.56	8.90
TAA 300	TO5	1 watt audio amp	2.90	2.70
TAA 521 Equiv. 709C				
TAA 840	D.I.L.	AM Radio tuner	3.20	3.00
TBA 221 Equiv. 741C				
TBA 281 Equiv. 723C				
UA 703C	TO5	RF.IF Amp	1.50	1.30
UA 709C (LM709)	TO3 or D.I.L.	General Purpose amp.	1.00	.95
UA 723C (LM723)	TO5	Regulator	1.50	1.40
UA 739C	D.I.L.	Dual OP amp. low noise	2.50	2.25
UA 741C	TO3 or D.I.L.	Operational amp.	1.20	1.10
OM 802			2.50	2.30

Digital Experimenters Packs

Specially produced for counter enthusiasts etc.
TTL 'A' has Datalit 707 plus 7490 plus 7447 to build a single decade counter. Only **$6.90**.
TTL 'B' as 'A' above but alos has 7475 latch to hold readout while counting Only **$7.90**. Both come with full instructions and can be cascaded.



Readout breakthrough

0.3" 7 segment LED readouts at below US and UK prices. Definately brand new end fully guarenteed. Huge bulk purchases sends prices crazy!
DL 707 (Common anode) or DL704 (common cathode), **$2.95 each $2.75 10 up.**

Silicon Bridge Rectifiers

High quality assemblies giving maximum ratings and reliability at minimum cost.

Type	Current	P.I.V.	1-9	10 up
MB1	1.8A	100	1.40	1.20
MB4	1.8A	400	1.80	1.60
MB8	1.8A	800	3.20	3.00
MB10	1.8A	1000	4.20	4.00
PA40	8A	400	6.00	5.75
PA60	8A	600	6.75	6.50
PB40	25A	400	7.20	7.00

Special Digital ICs

	1-9	10 up
9001	1.50	1.30
9368	3.20	3.10
95H90 300MHz Decade counter	19.75	19.00

Solid State LED Displays

		1-9	10 up
DL62	0.6" high	8.90	8.25
FND70	0.3" high	3.70	3.50

Special RF Transistors

		1-9	10 up
2N5589	7 Watt	6.50	6.00
2N5590	15 Watt	7.75	7.45
2N5591	30 Watt	9.85	9.35

Set of three for only $22.50

How to Order

1. Send your order with cheque, money order or postal note. Allow a minimum of 30 cents to cover packing and postage.
2. A minimum order amount of $2.00 applies, so it is better for you to place a few large orders than a lot of little ones (saves you P&P!!)
3. If you wish to receive goods COD, a prepayment of $2.00 must be sent with your order

DON'T FORGET TO PUT THIS PAGE IN YOUR 1973/4 DICK SMITH CATALOGUE or if requested we will send you a copy FREE with your order.

DICK SMITH WHOLESALE PTY LTD

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ctronics Centre

HAVE YOUR OWN LIGHT SHOW!!!

At last you can have a light show of your own — create those psychedelic light effects in your home, club or wherever. Dick has located the same gear that professionals use and just to see how they go, he has some special prices. Check the value of these projectors and wheels.

Aquarius 100 is a specially modified 100W slide projector with rotator mechanism for colour wheels and rim drive. Throws a 6' by 6' pattern at 12'. Supplied with FREE COLOUR WHEEL worth $14.00 for only **$58** (P&P $4.00).

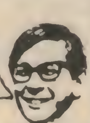
Aquarius 500 is more powerful and will produce images up to 30' diameter. Choose from 16 colour wheels at prices as low as **$17.95**. Exactly the same as professional equipment at twice the price. ONLY **$99** (P&P $4.00).

SPECIAL LENSES to create more fantastic effects Kaleidoscope **$16.80**, Duo-image splitter **$12.80**, Triple splitter **$34.00** (All P&P $2.00 or free with projectors). Build your own colour show. We have some 6" oil wheels which can easily be fitted to non cartridge type projectors. Simply devise a rim drive and you're away for only **$13.60** (P&P $2.00).

High Sensitivity Multimeter Special

This must be Australia's cheapest 20,000ohm/V multitester having 7 DC voltage ranges, 5 on AC, 3 DC current ranges and 2 resistance ranges. 34µA high sensitivity movement. Big, mirror scale. Off position for safety 3% DC accuracy. Normal Retail Price is $17.50, a few discounters have them at $15.00. Please support our bulk purchase (it's in your interest) ONLY **$10.50**. Yes Ten dollars fifty!! (P&P $1.00).

20,000 Ohm/V
ONLY $10.50

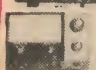


Did you see the Trio review in June E.A.?

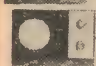
8UNM 18cms wide.

Quote "Trio have come up with a very attractive range of instruments that will find many applications . . . They are attractively styled and perform well." Prices include Sales Tax.

VT108 FET VOM 8 ranges 0.5 to 1.5kV, 11Meg input, ±3% accuracy. Ohms from 0.1 to 1000Meg. Memory feature. **$85**.



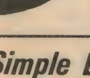
AG202A Audio Generator covers 20Hz to 200kHz 10V rms output. Sine and square wave. External sync. **$94**.



CO1303A 75mm Scope has 20mV cm sensitivity covers DC to 1.5MHz Input R & C of 1Meg and 30pF. **$170**.

SG402 RF Generator covers 100kHz to 30MHz in 6 ranges. Output 0.1V rms. High Low attenuator. Modulation at 400Hz **$76**.

Ferrite Toroids



Only while they last since we have purchased the entire stock of a well known manufacturer. Ideal for speaker lead suppressors (see June E.A'). Q1 material 2-30MHz, Q2 10-40MHz please specify

Type	Inside diam.	Material	Price
F4021/2	0.71"	Q2	70c each
F4041/2	0.65"	Q1 or Q2	65c each
F4040/2	0.455"	Q1 or Q2	60c each

Simple Electrical Kit Packs

These are very easy to build real working models. See how the basic principles work in practice. Four to choose from with full instructions and they are extra easy to build. No soldering needed and will give a lot of fun. Electromagnets pack **80c**; Bell **$1.00**; Motor **$1.50** (All P&P 50c).

WORLD WIDE RECEPTION

THOUSANDS OF TRANSMISSIONS, AND STATIONS THE WORLD OVER!

WE COULDN'T EVEN MAKE THEM FOR THIS FANTASTIC PRICE!

$49.50

ONLY THIS ONE

Solid State 13 transistor 5 diode Multiband/multifunction portable radio

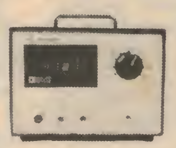
Although it isn't a true communications receiver, the 250 covers 535kHz to 12MHz including Marine and Shortwave bands; FM (it's time to get ready!) from 88 to 108MHz and the VHF Bands from 108 to 135 and 147 to 174MHz including aircraft and weather. Flip up lid has time zones calculator. 6V battery and mains operation. Ideal for NiCad cells having charger and indicator. Twin ferrite bar and telescopic antennas. Unique end controls give easiest tuning. Hours and hours of fun as you listen to the world. Only **$49.50** (P&P Free).
Bonus Extra. 'How to listen to the World' (see review June E.A. 74 p93). Normally $4.95. Supplied with radio for only **$4.50**.

TGS Gas Transducers in stock (E.A. June)

KITS

Price reduction for Digimeter

Such has been the popularity, that we have revised the kit and improved it. A professional instrument at an Amateur price thanks to the Analog Devices panelmeter with 0.05% ± 1 digit accuracy. Covers 200mV to 2kV and 20ohm to 200k. You can be really proud of this one which now has —



Bonus Equipment

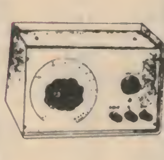
Two EZ hook probes • Vinyl covered instrument case • Highest quality instrument selector switch • Instrument type terminals. All at new low price of **$139.00** (P&P $2.00).

Musicolour II

is an easy to build, ever changing light display activated by your Hi Fi. 3 channels of filtered audio control up to 3kW. As the music plays the lamps produce a psychedelic kaleidoscope of colour. Easy to build in posh vinyl-clad case with attractive front panel. Still only **$52.00** (P&P $2.00).

Audiophile Test Gear

enables you to check the performance and experiment with your gear. No need to spend a fortune.



LOW COST AUDIO GENERATOR

covers 15Hz to 20kHz with an output of 1Vrms over the range. Simple to build and ideal for tweeking up your system. Featured in EA June 70 and still the best 4 years later! Complete kit includes handsome plastic case with matt finish aluminium panel **$15.50**.

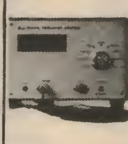
Semi-professional 7 transistor audio signal generator

Covers 15Hz to 150kHz with sine or square wave output in 3 ranges 0-10mV, 0-100mV, 0-1V. Built on high quality PCB with thermistor stabilisation. A built unit as good as this would cost a lot more. Ideal for clipping tests on amplifiers as well as general setting up use. Attractively finished to look professional and only **$30.50**.

Ferranti ZN414 Microradio IC kit

(as featured in Electronics Australia May 74). At last you can build a true miniature radio. IC features a 10 transistor circuit which requires only tuned circuit and 3 parts. 72db gain. Operates on 1.5V and only 300uA. We've seen one in half a matchbox, can you beat it? No case supplied because you'll want to build it your way. Regular kit $9.75 or Minikit still available on special offer at only **$6.75** (see article).

Digital Counter



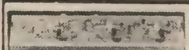
(E.A. DEC., 73)
We have adapted this kit to fit the same case as the very popular Digimeter. Features handsome vinyl finish and posh etched front panel (see June E.A. p111). Side by side the two look great. No one will believe you built this 200MHz counter. Complete kit is **$135** and includes the prescaler. Basic 20MHz job is only **$116**. At last someone has taken the trouble to make kits look professional — US! See them at the Electronics Centre.

Built the ETI Superkit 100Wrms Amplifier

Kit 422A Pre-Amp consists of the 420B PCB and all components for the low noise Pre-Amp including fibreglass board **$24.50** (P&P $1.00).
Kit 422B Main Amp and Power Supply consists of the ETI 422 Power Board (fibreglass) and all electronic components for it and the power supply including transformer. **$62.00** (P&P $1.50).
SPECIAL COMPLETE KIT FOR ONLY **$118.00** includes all sections ABC above and full instructions (P&P $2.50). On a limited budget? Then get Kits A and B only and supply your own hardware. Special price only **$82.50** saves you $4.00. Or fit it in your own cabinet by ordering full kit less cabinet for **$113.00**. Missed the article? Then send us a stamped self-addressed envelope (foolscap) and we will send full details.
Separate components available.
ET1420B Pre-Amp Board (fibreglass) **$2.80** ET1422 Amp Board **$3.60**. 2500 50v electros; **$1.80 each**. McMurdo 2900-4 switch **$3.60**. 9504 3577 Transformer **$11.75** (P&P 75c). McMurdo 2904 1 switch **$1.40**. Front Panel **$3.50**. Chassis **$6.90** (P&P 75c). McMurdo phone jack **75c**. WBF003 3 heatsink **$1.90**. LED Indicator **$1.45**. Teak cabinet **$8.00**. (P&P 75c). 4 input RCA strip **80c**.

"BEAT THIS SUPERKIT VALUE" WITH OUR EXCLUSIVE FIBREGLASS BOARDS.

R.F. Amplifier Kits



(See review in E.A. Jan. 74).
Only available from Dick Smith and specially for Amateurs. The popular 144MHz circuit has now been adapted to 52MHz using the same transistors (but saving one stage).
144MHz 30W out from 300MW: 7W stage **$11.50**, 15W stage **$13.50**, 30W stage **$17.50**. Individual circuit boards **$1.50** each (state which). Transistors 2N589 **$6.50**, 2N5590 **$7.75**, 2N5591 **$9.85**, COMPLETE KIT (saves $5) only **$37.50**.

Playmaster 136

continues to be so popular and little wonder, it's such outstanding value. Full 15W RMS per channel. Under 0.2% distortion. Overload protected. All this in a Superkit with brushed aluminium panel etc for only **$65** (P&P $1.00).
NEW TEAK SLEEVE FOR THE PLAYMASTER gives the very latest look for ONLY **$8.00** (P&P $1.00).

New computerised resistor packs

You know the usual resistor packs with 2 or 3 resistors of every value including 33ohms, 18k and 39k that you hardly ever use? Well ours is different. It's based on a Philips computer listing which shows the values that are used the most. So our pack contains 20x1k and only 2x56ohms. However there are at least 2 of every value from 22ohms. to 470k. A total of 50 different values and over 260, ½W, 5% carbon film resistors. Normal Value over $8.00. Ideal for service people and hobbyists and only **$6.50** (P&P 50c).

ONLY $6.50

Forum

Conducted by Neville Williams

A circuit that stumped them in the 30's

Our reference in the April issue to simple but tricky circuits had an unexpected result, namely to unearth one that we had completely forgotten about and one that caused arguments all around the world: the Barnes "mystery circuit". If you can remember it you're really a veteran enthusiast!

The circuit in question was for the audio end of a receiver, and it made its debut in the May 17, 1935, issue of our forerunner publication, "Wireless Weekly". It was submitted as an entry in a reader "Circuit Competition" and was published, as a matter of interest, over the caption: "Can anyone explain why this circuit works?"

When a complete receiver using the circuit was exhibited, along with other entries, it attracted enormous attention and the exhibition bulletin board was a magnet for correspondence and onlookers concerned with what rapidly became known as the "Barnes mystery circuit".

The title was confirmed a few weeks later, in the June 14 issue, which devoted the best part of four pages to summarising the explanations sent in by readers. Another swag of letters appeared in the July 5 issue, supplemented by observations from the then Technical Editor. They make fascinating reading, the more so because it is fairly obvious that the Technical Editor was far from clear himself at the time.

But why all the interest?

Well, the circuit emerged at a stage when enthusiasts were getting really involved in audio systems, mainly to do with radio receivers. They had better dynamic loudspeakers and better mains-operated valves to work with, and the clumsy transitional extensions of the battery era had been left behind.

The next desirable objective was a push-pull amplifier, with its promise of still higher power, reduced distortion and balanced current through the output transformer primary, leading to better bass response.

But a push-pull output system represented a significant complication at the time. Driver transformers were either expensive or dubious in their frequency response and likely, in any case, to pick up hum from the power transformer. The then novel phase splitter could suffer from hum due to heater / cathode leakage and offered no gain — which seemed like wasteful use of a valve!

Then came Mr Barnes (Alf Barnes, I think) who suggested the circuit shown. It involved a type 2A5 output pentode driven in the usual way by the preceding stage — a 2B7 diode pentode. In this respect, the two valves were equivalent to their counterparts in an ordinary single-ended amplifier.

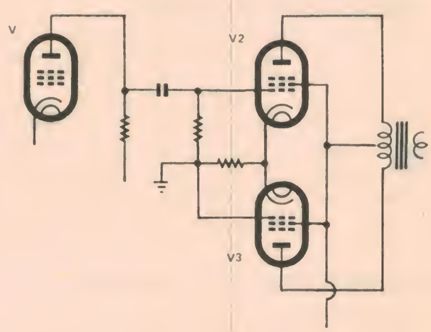
However, a second 2A5 was added, with its cathode sharing a common resistor with the driven valve, its grid earthed and its plate fed via the other end of an ordinary push-pull output transformer. The circuit was published and the arguments started.

Some testified that the circuit worked, and left it at that. They were content to enjoy the end result and to regard the operation as a "mystery".

Others devised practical tests, theoretical analyses, and explanations ranging from whimsical to weird.

Still others took the firm view that a valve with its grid earthed could not possibly work and anyone who said it did was merely having themselves on!

It is easy nowadays to be snooty about the whole thing but remember that we are talking about 1935, when a lot of now-familiar techniques were virtually unknown — things like grounded grid amplifiers, cathode coupling, negative feedback, &c.



Few enthusiasts possessed a decent multimeter, let alone things like audio generators and oscilloscopes, and, without all this background, it was easy to become confused.

Because of these factors, the "mystery" became so involved and so entrenched in the minds of enthusiasts that it still tends to be cherished as a mystery, despite the efforts of yours truly and others to dispel it.

From where we now stand, the circuit holds no mystery and we can readily nominate the various factors involved. The problem is purely one of determining the relative magnitude of those factors for different valves and different operating conditions. Given the time and inclination, it would be relatively easy to do practically but, as we mention later on, it could be quite involved as a purely mathematical exercise.

Now to the letter:

Dear Sir,

I was interested in the "simple circuits" discussion in your Forum column, and it reminded me of an article in the English "Radio Constructor" for March 1955. You may recall this. It concerns what had become known as the "Barnes mystery circuit".

Since I was in England at the time, I wrote to the magazine informing them that I first became familiar with the circuit in the mid '30s when it was incorporated in a radio receiver or amplifier entered in a competition conducted by the old "Wireless Weekly".

Either you or your predecessor wrote to them at the same time informing them that the circuit was devised by a Sydney man called Barnes and that it was so identified by us in Australia.

Perhaps you would like to throw this one in for discussion by some of your younger readers.

As we are now well aware, the improvement in quality is due to the reduction or elimination of direct current saturation of the output transformer core.

In fact, when using single-ended output stages, as I have done for some time in short-wave receivers, I use push-pull output transformers in place of the usual single winding one. I use the centre tap to feed the anode at one end and the rest of the set from the other end — sufficient in some cases to balance the anode current drain.

This produces an improvement in quality, depending on the quality of the output transformer used.

I hope this arouses some interest.

(W.R., Wangaratta, Vic)

Well, let's see if we can get rid of the "mystery" once again.

When a signal is applied to the grid of V2, the resulting variation in cathode current will produce a similar in-phase voltage at the cathode — provided it is not bypassed. This is by ordinary cathode follower action. Typically, a positive half-cycle on the grid will increase the current through the valve, producing a positive half-cycle at the cathode.

This positive pulse will also appear at the cathode of V3; if its cathode swings positive and the grid remains at earth potential, current through the valve will decrease, complementing the increase through V2. In other words, even though the grid of V3 is earthed, it will receive signal drive via the common cathode connection in the correct phase for push-pull operation.

Against a background of modern circuit practice, we would sum this up by saying that V3 is operating as a grounded-grid amplifier, with common cathode coupling to V2.

Fairly obviously, in this particular circuit configuration, we must envisage a limiting condition, which rules out the possibility of the system being fully balanced push-pull. For this to be the case, the current excursions through V3 would be equal to those of V2, but opposite in phase. The current through the cathode resistor would remain constant, as would the voltage across it, and

there could be no signal drive for V3!

It follows that the circuit will assume some intermediate state in which V3 will receive some drive, but never enough for full, balanced push-pull operation.

At this stage one might be prepared to settle for the concept of partial push-pull, but let's not jump to conclusions too soon.

Some will have realised by this that the circuit has some things in common with the more recent "long tailed pair" phase splitter, familiar in both valve and solid state circuitry. There are important differences, however.

In a low current, resistance coupled stage, it is possible to arrange an artificially large value of common cathode or emitter resistor, to increase the interstage coupling, without involving a significant waste of power. It is also possible to use different values of plate load for the two stages to ensure that their output voltage is closely balanced, giving a true push-pull output signal.

But, in the circuit under consideration, the plate of V3 must undergo a voltage swing equal to, and out of phase with that of V2, if only because they are connected to opposite ends of a centre-tapped transformer winding. It would appear that some of the verbal contestants, in Australia and elsewhere, failed to realise this very simple fact; they measured the output at each plate, either with an AC voltmeter or a CRO, found them the same, and came up with the verdict "perfectly balanced push-pull".

In fact, because V2 has to swing the plate of V3 through the full output signal cycle, there is a chance that it will see the natural output impedance of V3 as an actual load across the opposite half of the output transformer. As such, V3 could conceivably absorb power from V2 and actually reduce the available undistorted output, rather than augment it.

Try the circuit for size, some time, if you want to test your prowess as a mathematician. Derive a value for the plate resistance of V3 as a grounded-grid output stage and determine how that figure of plate resistance would be modified by whatever partial drive the stage receives. Figure out whether the plate resistance will be positive (thereby absorbing power) or negative (thereby contributing power).

For an encore, you might care to look at the load conditions of V2. In a conventional class A push-pull circuit, each valve looks into a load which is higher than the turns ratio might suggest, because the opposite valve is complementing the effort. If the lower valve is making no contribution, or only a limited contribution to the transformer output current, then V2 will be trying to supply energy to the load through a turns ratio of half-primary to full secondary. Almost certainly, it will be looking into a less than optimum theoretical load.

Perhaps fortuitously, circumstances conspired to favour the Barnes mystery circuit at the time it appeared. The 2A5 output valve, popular at the time, had a comparatively high output resistance and, even if not driven at all, would have imposed minimum loading on the bottom end of the output transformer. Also, having a relatively high transconductance, the valve would have been able to make best use of the available drive.

As for the load presented to V2, the chances are that, with push-pull transformers of the day (twice the single-ended load) and the highly reactive loudspeakers, the conditions may not have been too far astray.

The observations about balanced DC through the output transformer would also be valid. It is reasonable to conclude, therefore, that while the mystery circuit could not have been the equal of a fully balanced push-pull system, it would almost certainly have had the edge on a single-ended stage in terms of sound.

But remember that the remark applies to the circuit as published and to the component situation at the time. The answer might have been quite different had the brainwave popped up when the "in" valve was the 2A3 low impedance power triode.

And this brings us around to the observations by W.R. and the assumption that the advantage of the circuit lies in balancing the DC component. It is a plus factor, to be sure, but it is one that could be completely swamped if the penalty is excessive resistive loading across half the output transformer, and an unacceptable reduction in the effective load seen by the driven power amplifier.

The idea suggested by W.R. of supplying the rest of the receiver from the unused end of the output transformer is particularly suspect.

Let's assume an output stage operating at 250V, 50mA and requiring a load of 5000 ohms; further, that the rest of the receiver has been arranged to draw this same current for exact balance. By ordinary transformer action, this loading must be seen by the output valve plate as a resistance of not less than 250 / .05 or 5000 ohms.

In other words, W.R. might effectively be shunting his output stage with a load which will absorb roughly half the available power.

In fact, that's only the beginning. It would be absolutely essential to decouple the supply to get rid of the output voltage swing and a decoupling network to cope with anything like 50mA would have an input impedance even lower than 5000 ohms.

Again, it would be most unlikely that W.R. would be able to provide an output transformer having twice the number of turns and four times the impedance of a single-ended 5k component. He would more likely end up with one which would reflect to the output valve much less than the optimum figure.

Add this mismatch to the shunt loss already mentioned and the ultimate performance of the output stage would be pretty pathetic. DC balance at a price — but what a price!

Incidentally, there is a subtle but vital difference between 50mA drawn by the rest of a receiver, and the same order of current drawn by a pentode or tetrode output valve, as in the original Barnes circuit. The valve might draw as much current as a 5k resistor but its dynamic plate resistance (what it looks like when you swing plate voltage) would be at least 50k in normal mode and somewhat higher again as a grounded grid amplifier.

Incidentally, if all this talk about valve technology puts you off, stop worrying. Substitute emitter, base and collector of a power transistor for cathode, grid and plate of a 2A5, and you can carry right on with the argument!

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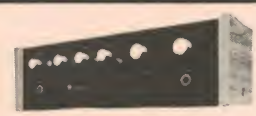

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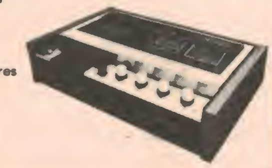

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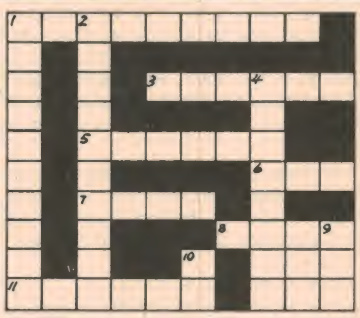

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The Serviceman

Another long term intermittent

Last month I related a tale of woe about the longest intermittent hunt in history, which turned out to be a faulty chassis connection. As if to emphasise just how insidious such faults can be, here are a couple more, one of which took nearly 12 months to track down.

The first story concerns a TV set by the same manufacturer as in last month's story, although it was a different model. I don't imagine that this was anything more than coincidence. More precisely, the set was a 17in portable type, moderately old, but good for several years in the normal course of events.

The complaint was picture failure and, the first time I was called to it, I had no idea it was intermittent. As I usually do, I first checked for EHT and found that there was none. I was about to check or replace appropriate valves when suddenly the set came good, and nothing I could do would cause it to fail. All I could do was request the owner to call me when the set failed again.

It was a couple of weeks before I heard from him, then he reported that it had failed again. Fortunately, I was able to answer the call immediately, so I advised the owner not to touch it or switch it off, and that I would be there shortly.

Fortunately, the fault was still in evidence when I arrived. Knowing how touchy it could be I approached it with caution. Since I had already established that it involved an EHT failure, I started out with a visual inspection of the line output stage.

Again I was lucky. I was able to see that neither the 6AU4 damper diode nor the 6CM5 line output valve had any heater glow. Well, that seemed straightforward enough. All I had to do was find an intermittent connection in the heater wiring.

In this model set, these two valves and their associated components are mounted on a small sub-chassis. This, in turn, is mounted on the main chassis at two points. At one, a self tapping screw passes through a clearance hole in the sub-chassis into the main chassis. At the other a machine screw passes through a clearance hole in the sub-chassis into a punched metal clamp. This latter is made from "oxidised" metal, is folded so as to clip over the edge of a metal sheet, and has teeth punched into it which form a rudimentary thread to engage the screw.

Immediately I realised that the filaments were not alight I reached for a screwdriver to remove the sub-chassis and examine the heater wiring. But I didn't get that far. A half turn on the self tapping screw and I realised the heaters were alight. Sure enough, after the appropriate interval the set came good.

The explanation was now quite obvious. The heater circuit had been "earthed" to the sub-chassis and the screws holding this to the main chassis were depended upon to complete the circuit between the two. But in spite of the apparently reliable nature of these two fastenings, they simply were not good enough. For some reason, not readily apparent, they formed a high resistance joint. A short length of hookup wire as a bonding strap between the two chassis cured the trouble once and for all.

Surely there is a lesson here for the set manufacturers. Construction of this kind simply is not good enough. Nothing short of a wire bond between the two units, such as I had to provide, is adequate in such a case.

Granted, this is one more operation for a wiring hand and must represent an increased production cost. On the other hand, what about the manufacturer's reputation. It doesn't take many faults of this kind — remembering how costly and generally inconvenient intermittents can be — to give a brand a bad name; a name that will stick for a long time.

To be fair, I doubt that the manufacturer was seeking to cut costs when he adopted this method of assembly. I imagine that he was trapped into believing that the setup would be completely reliable. (I confess I was surprised when it wasn't.) But I think that this is the lesson to be learned; that a chassis connection is not always automatically a good one, either at the point of connection itself or elsewhere in the chassis assembly.

In short, making a connection to the nearest piece of metal, on a "she'll be right mate" basis, leaves too much to chance.

The automotive boys could well take heed of this advice also. The second story, the result of a recent experience by a friend, suggests that they have exactly the same problems within their industry as we have in ours.

My friend's car is about six years old — or it was when this trouble first appeared. It concerned the right hand turn indicator blinkers. When the trouble occurred — and it was just as intermittent as any TV set I have ever described — the flash rate would increase markedly and both rear blinkers would flash at the same time!

At the front only the right blinker operated, but with the increased flash rate. The left blinker system behaved normally at all times. It appeared that the trouble was more likely to occur in wet or cold weather.

It was disconcerting to say the least. Every time it happened my friend visualised all the dreadful consequences, legal and otherwise, which it could cause. I imagine it was equally disconcerting for the following drivers.

And, as my friend put it, "It's seldom practical to get out and investigate the problem when it happens. You have to wait until you get home — by which time the thing's fixed itself."

Nevertheless, he made several attempts to come to grips with it. He is reasonably experienced in matters electronic, being an enthusiastic home constructor of amplifiers and similar equipment. And, on a couple of occasions, the fault did show up when it was convenient to investigate it. But it didn't help much. As soon as the wiring around the rear tail light assembly was touched the fault vanished. Also, a careful examination of all the connections revealed nothing wrong.

The next step involved an auto electrician. It so happened that the starter motor was in need of attention so, when he submitted the car for this work, he mentioned the blinker problem and suggested that it be investigated.

This achieved nothing. While not doubting that the fault existed, the auto electrician reported that he could find nothing wrong. And without an obvious fault, there was nothing he could do to fix it.

Nevertheless, the fault seemed to cure itself for some months after this, probably because the weather conditions happened to be favourable. Then it started to play up again and, after a couple more attempts to come to grips with it, the owner confided in me. By this time the fault had been around for the best part of 12 months.

It wasn't really a request for help, or a suggestion that I should attempt to fix it; it just came up in the normal course of conversation. As far as that goes, I don't pretend to understand all the finer points of automotive wiring. While the basic circuits are quite elementary, their practical execution can represent a proper nightmare to anyone not familiar with their layout. On this basis I can't take much credit for what followed.

"If I had to hazard a guess," I commented, "I would say you have a faulty chassis connection somewhere. These can produce some strange alternative paths and equally strange results; every bit as strange as the one you describe. And the fact that you've already checked the obvious connections would tend to support this."

My friend seemed to get a lot of encouragement from this remark.

"I never thought of that," he confessed. "I suppose I took the chassis connections for granted."

And he hurried off to do battle afresh.

It was about a week before I saw him again, and I had almost forgotten the matter. Then he bowled into the shop all smiles.

"You were right, it was a faulty chassis connection. But you'd never guess where."

"I wouldn't even try," I replied.

Then he told me the whole story. Without any prompting from me he had tried one of the tricks which I have often used on intermittent faults. Where the symptoms or history suggests a certain type of fault it is often practical to deliberately create this

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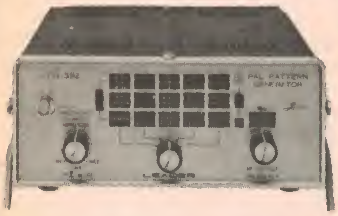

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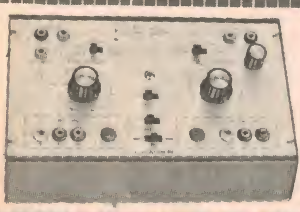

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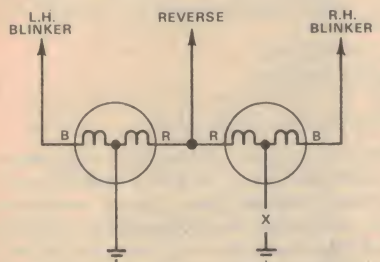
fault, then check whether the symptoms match exactly. If they do, it's a fair bet that your hunch was right.

In this case he had simply created a faulty chassis connection by the elementary process of pulling the lamp and socket assembly out of the tail light housing. Immediately he did both blinker globes started to flash at a high rate.

Well, that had at least pin pointed the general nature of the fault. It now remained to track down its actual location. My friend's first reaction was to blame the connection between the metal tail light housing and the chassis proper. The housing was held on with four machine screws, nuts, and appropriate washers. There was a certain amount of rust and grime around all of these, and he spent some time cleaning it up and reassembling it.

Then he tried again, by simply pressing the chassis contact on the lamp socket hard against the tail light housing. Unfortunately, his efforts appeared to have been in vain, for the fault was now very much in evidence.



Simplified circuit showing the connections to the rear blinker lights and the reversing lights. When the chassis connection failed both reversing lights functioned as blinkers.

At this point, he made a further discovery. The globe in question has two filaments; one for the blinker and one for the reversing light. And it was the reversing light filament which was flashing when the fault occurred, not the blinker light filament. While of academic interest at the time, it was a useful piece of information later.

Getting back to the fault proper, he spent some time trying to establish whether it was in the temporary chassis connection he had made, or whether it was in the socket itself. After a lot of fiddling, and a couple of false leads, he concluded that it was in the socket.

Yet the socket seemed an innocent enough device, and he could see nothing obviously wrong with it, or any place where such a fault could occur. It was of moulded plastic and fitted with three contacts. Two served the active pins on the base of the globe, while the third was a simple wiping contact which pressed against the side of the metal base.

This contact was also part of a more elaborate contact system; a set of six fingers around the outside of the socket which performed the dual function of retaining the socket in the lamp housing and making the electrical connection to it.

These fingers were closely examined, checked for tension, and cleaned. The contact against the lamp base was similarly checked for tension and cleaned. Yet the fault remained.

Finally, my friend fished out his ohmmeter and began to make specific measurements. He managed to get one prod against the metal lamp base and the other on the metal fingers. The meter showed open circuit. Removing the globe he measured between the lamp contact and the fingers. Again, open circuit, even though this appeared to be one piece of metal.

And that was where the catch was. The two contacts were not one piece of metal, even though it needed a close look to confirm this. The fingers were extensions of what can best be described as a large metal washer, held in a retaining groove in the plastic moulding.

The lamp contact appeared to be an extension of the same piece of metal and, I imagine, it could have been had the punching die been so designed. But it wasn't. It was a separate piece, fitted under the finger washer, and in contact with it only by reason of a rather dubious mechanical assembly.

And this was where the fault was. A certain amount of fine dust and moisture had found its way into the lamp housing over the years and created a thin layer of mud over the socket. Apparently it had penetrated between these two pieces of metal, making an effective, if intermittent, insulator.

The cure was simple. A hot soldering iron, a dab of flux, and a neat blob of solder bonded the two pieces of metal together permanently.

My first reaction, when my friend showed me the evidence, was simply to ask why. Why did the socket manufacturer choose to make this contact in two pieces rather than one? It could not have been an economy measure because the two pieces would cost more than one, both to make and to fit. So the socket represented a more expensive way of doing a less effective job.

Cause of the flasher fault. This is the companion socket, from the left hand tail light housing. The separation of the two metal pieces (circled) was more obvious in this unit that the right hand one. It was also beginning to give trouble.

While the philosophy behind the design will probably remain a mystery, one thing is certain. It represents a built-in failure mechanism which could be almost guaranteed to function after a few years. More cynical types might even claim it was a deliberate attempt at built-in obsolesence, but I don't really believe this. As far as I'm concerned it is simply an example of poor design.

Finally, why did the system behave as it did? My friend had traced out enough of the wiring to make a rough circuit and a tidied up version is reproduced here.

As can be seen, the two filaments shared a common chassis connection so that, when this connection failed, they were effectively in series and, in turn, in series with the reversing filament in the left hand globe, which was connected to the chassis.

Thus, there were three filaments in series being fed from the blinker circuit. The lamps were 21/6W types, the 21W filaments being used for the blinkers and the 6W ones for the reversing lights. With all three in series the low resistance of the 21W filament meant that very little voltage would be developed across it, most of the voltage being applied across, and shared by, the two 6W filaments.

Granted, they did not light as brightly as when they were operating from the full 12V supply but, even with 6V applied, they gave off enough light to be seen, particularly at night.

The moral of these stories is, I think, summed up in my friend's earlier remark, when I suggested that it might be a faulty chassis connection: "I suppose I took the chassis connections for granted."

Surely that is the crux of the problem. We — and that includes servicemen, set manufacturers, and component manufacturers — do take chassis connections for granted. Whereas other connections will be either soldered or via well designed plugs and sockets, a chassis connection is made by fitting a lug under any old screw or nut, ignoring the presence of paint or the possibility of future rust, foreign matter, etc.

Until we learn that a chassis connection needs to be made with as much care as any other, we will continue to create problems of this kind.

Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

Musical note synthesiser

I refer to your article on pages 44 and 45 of the May, 1974, issue, headed "Musical Octave Note Synthesiser" and written by S. H. Dolding. Is the article complete? You have not signed it off with the usual E-A in a circle, and in the text there is a reference to figure four, whereas I can find only three diagrams. I cannot find any more of the article elsewhere in the same issue.

Could you explain how the binary code used was derived, and would it be possible to extend the scale to other octaves by extending the diode matrix? If this can be done please advise to what limits I can extend the scale using a 1MHz crystal as suggested in the text.

K. W. George (Wantirna South, Vic).

COMMENT: The article is complete, although the usual end symbol was inadvertently left off. All four diagrams are reproduced, Figs 1 and 2 being together on page 44. The derivation of the binary code used for the programmable divider is explained in the article, being based on the ratio of 1.05946:1 between the notes of the tempered musical scale. You do not need to extend the basic diode matrix in order to cover additional octaves, as these are simply obtained by means of the outputs from IC7, the output divider. As it stands, you have the choice of four octaves; further lower octaves could be provided by additional flip-flop dividers. Of course if you want to use the scheme for a monophonic organ, the various octave outputs would need to be gated, and this might call for additional diodes if the keys have only single contact sets fitted.

World Record Club releases

I hasten to correct a misconception held both by yourselves and apparently by a significant proportion of our membership. This is, that once a record passes its scheduled month of issue, it cannot be obtained by a member who neglected to order it when it was first announced.

Such is not the case. Every record in every programme is available for order throughout the currency of that programme.

If this facility to "back-order" was not available, then existing members would clearly be at a disadvantage compared with newly enrolling members, who may select any record both past and future from the programs sent to them in answer to their enquiry.

To make this point clear, perhaps I can set down briefly the condition of membership the Club imposes: this is that a member must order one record a year to remain a member. When he fails to order one record in any year, he is automatically dropped from membership. I should add that he is offered or re-offered more than 700 titles a year to choose from!

This obligatory one record must, however, be ordered from one or another of the seven programmes each member receives on the official order form accompanying each such programme. In other words, a record "back-ordered" (as a result, perhaps, of seeing a review in your journal) does not qualify as the obligatory record. It is due, perhaps, to this condition that the confusion has arisen.

I hope this clarifies the position.

John F. Day, Managing Director,
World Record Club,
605 Camberwell Rd, Hartwell, Victoria 3124.

COMMENT: There certainly has been widespread confusion on the point which Mr Day explains above. Readers will be able to obtain records from the WRC, though they will not necessarily satisfy individual member obligations. On this basis, we should be able to resume reviews of Club releases, the main requirement being to ensure that reviews are not unduly delayed. It is now over to the WRC to make appropriate recordings available to us, early in each programme.

Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

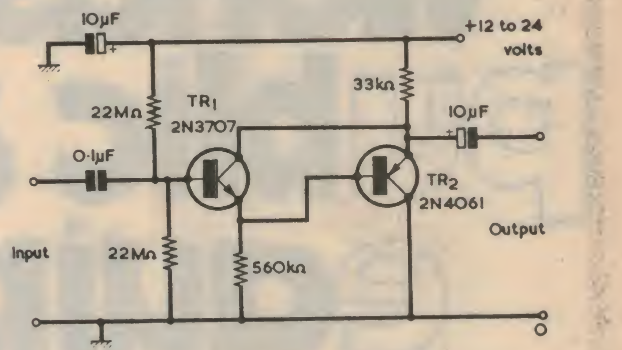
Impedance matcher for crystal mikes, ceramic pickups

In ordinary domestic tape recording a crystal microphone is often used for reasons of economy and sensitivity. Similarly in a record player of modest performance a ceramic cartridge may be used. The normal requirement for these transducers is that they have a high impedance load, so that the low frequency output of what is essentially a capacitive source is preserved.

The self-capacitance of a ceramic cartridge would typically be 1000pF and for the lower 3dB down point to be at 20Hz this demands a load impedance of 8M. In practice several cartridge manufacturers recommend lower impedance (about 47k or 1M) but our figures give us the order of input impedance required.

Since most transistorised circuits have lower input impedances (in tens of kilohms) a high-to-low impedance matching unit is required. Several different circuit arrangements are possible but the one shown here has several advantages. The circuit uses a complementary emitter follower configuration, in which the emitter of TE2 can be connected directly to the collector of TR1. This bootstraps the collector of TR1 and holds its base to collector potential constant at 0V even at high signal levels. The low collector to base potential reduces the internal feedback capacitance and helps maintain a good frequency response.

It is interesting to note that for this particular application there is no real need to maintain a very low input capacitance, since the source impedance is also reducing as frequency increases.



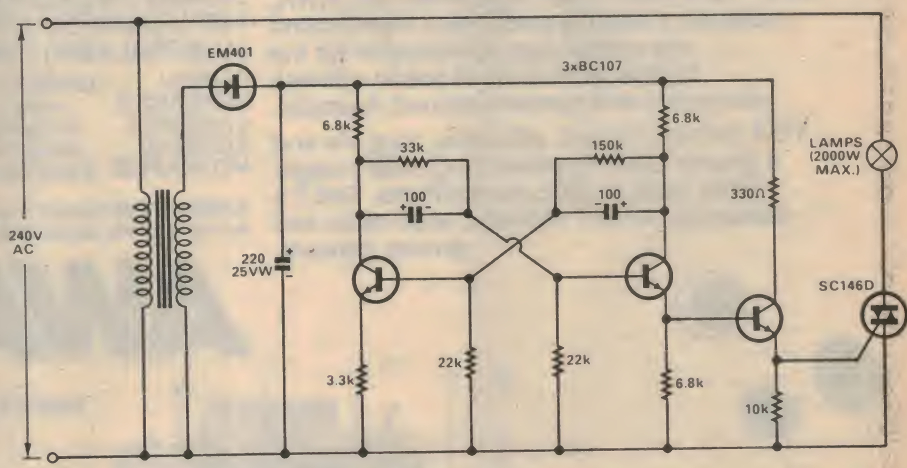
However, the circuit is useful for instrumentation applications where this condition may not apply. The 22M bias resistors will shunt the input but a high input impedance can still be achieved without difficulty. For this circuit it is typically 6 to 8M. The performance is well defined by negative feedback, whereupon almost any modern high gain small signal silicon transistors can be used.

(From "Radio & Electronics Constructor".)

Flasher for 240V incandescent lamps

This solid state lamp flasher will handle tungsten lamp loads to 2000 watts or resistive loads to 2400 watts and it is ideal for flashing safety lamps in test bays or on danger signs. With the values of the multivibrator timing capacitors and resistors shown in the circuit diagram, the "on" period is 2.5 seconds and the "off" time is 2 seconds. Both these periods may be altered by changing the parallel resistor-electrolytic capacitor combinations, thereby altering the multivibrator switching sequence.

A power transformer with a 12V secondary winding feeding an EM 401 or similar diode, provides about 15V DC for the multivibrator and switching transistor which controls the gate of the SC146D triac. Although very little power is dissipated in the triac (about 15 watts with a 2000 watt load) it should be mounted on a heatsink. It is essential to insulate the triac or, better still, the heatsink, as the tab of the triac carries 240 volts. Avoid short circuits in the load circuit as these will destroy the triac. If small lamp loads (under 200 watts) are envisaged, then the triac may be operated without a heatsink and a 1A fuse could be inserted in the load circuit to help protect the triac from short circuits.



(By Mr B. Fowler, 12 Leader St, Padstow, NSW). Editor's Note: It may be necessary in some cases to fit RF interference suppression components to this circuit, to prevent it feeding regular "clicks" into nearby radio sets and audio systems.

Capacitance meter uses single CMOS IC

The simple capacitance meter described here is very easy to use, requiring only the connecting of the unknown capacitance to a pair of binding posts and operation of a single rotary switch. When the correct range is found, the meter will indicate upscale to give the capacitance value. The indications on the meter scale are linear and the instrument covers a range from 100 pF to 1uF. If desired, an external digital multi-meter or VTVM can be used as the readout instead of the built-in meter. Since

the meter is powered by an 8.4V or 9V its operation is independent of the power line.

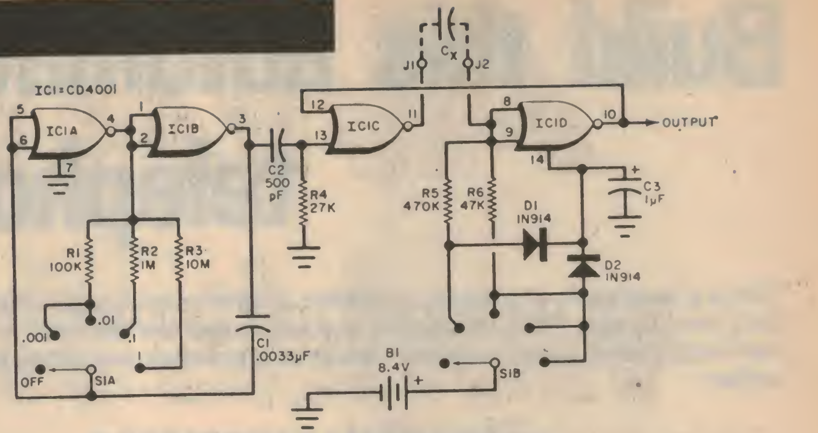
Most of the circuit (Fig 1) is contained on a single IC, a CMOS quad NOR gate whose extremely low power requirement ensures long battery life.

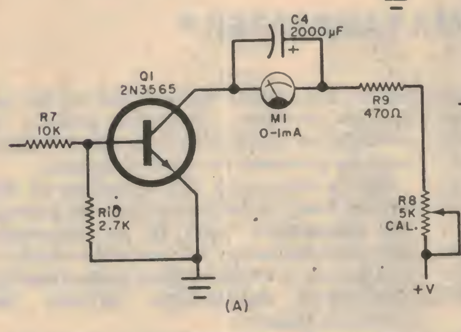
Gates IC1A and IC1B are connected to form an astable multivibrator whose frequency of operation is determined by the value of C1 and a resistor selected by S1A. This signal is coupled through C2 to trigger IC1C and IC1D, wired as a monostable pulse generator whose output pulse duration is determined by the value of the unknown capacitance (Cx) connected between J1 and J2 and the resistance value selected by S1B. If the selected resistor value is accurately known, the output pulse duration is then determined by the unknown capacitor.

In the prototype meter the output pulse duration is measured by the circuit shown in Fig. 2A, where the readout is on a milliameter. In this circuit, Q1 is used as a saturating switch while R8 is used to calibrate the meter. Since the meter indicates the DC flowing through Q1, and since the amount of DC is directly related to the pulse duration, the meter can be calibrated directly in capacitance. Capacitor C4 is used to integrate the pulses appearing across the meter; it thus removes the AC component.

The circuit in Fig. 2B is used when an external digital voltmeter or VTVM (1-volt DC range) is used as the readout instead of M1. In this circuit, R11 and R12 operate as a voltage divider while C5 filters out the AC component.

(By H. Garland and R. Melen, in "Popular Electronics").





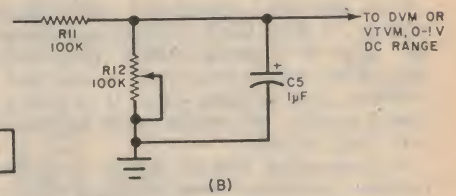


Fig. 1 (top) shows the basic circuit of the meter, less metering. The unknown C forms part of a monostable. Fig. 2 (A) and (B) show the way internal and external meters are connected, respectively.

TTL pulse detector uses 60c IC, LED

When one is testing an experimental logic circuit, or troubleshooting in a completed digital instrument or system, it is often necessary to detect single, fast pulses. At times this can be surprisingly difficult, even using a wideband scope with extensive triggering facilities. Some logic probes have provision for "stretching" short pulses, but even this can be of limited help.

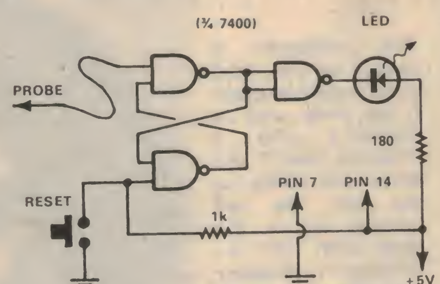
I have found the simple circuit at right very useful in this sort of situation. It will only detect negative-going pulses, but in practice this has not proved a problem as it is usually possible to look for a pulse where it is negative going.

As you can see, it is a simple R-S flip-flop formed from two gates of a 7400 IC. A third gate is used as an inverting driver for the indicating LED. The circuit is reset before each "search" by pressing the pushbutton.

If the probe is taken down to the low logic level (0.8V or less) for even as short a time as about 10 nanoseconds, the circuit will quickly flip over to the set state and latch there, indicating that a pulse occurred.

Almost any low cost LED can be used, so that the total cost should be less than $3.

(By Jamieson Rowe, EA)



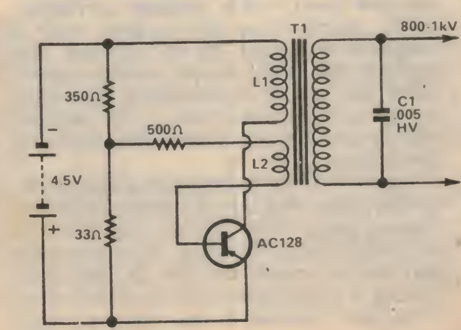
Simple 800V inverter

The circuit uses a PNP transistor which should be fitted with a heat sink. The battery current is about 250mA but varies with the secondary load.

The secondary voltage varies with the load and it is important that a load always be connected when the battery is on to prevent overheating of the transistor.

The choice of transformer is not critical but it should have two LT windings with L1 at least twice the voltage of L2. C1 is chosen to have a high reactance at the frequency of operation.

(By J. Hollis, in "Practical Electronics".)



Build this automatic telephone exchange

This is a description of a simple automatic telephone exchange which can be built from surplus PMG telephones and exchanges components. It may be built simply as an educational exercise or as a practical inter-office telephone system.

by GRAHAM LEADBEATER *

The Private Automatic Exchange (P.A.X.) is often used in offices to remove the load of internal traffic from the telephonist, who is then freed to deal with incoming and outgoing calls. It is thus a closed system, not connected in any way with PMG circuits.

A commercial P.A.X. can be a quite complex system, catering for heavy traffic (many calls at once) and a large number of lines (50 to 100 are common).

The system described here is not intended as a competitor to such systems. It provides (in its simplest form) for up to 10 lines and can handle only one call at a time. While the latter restriction may appear to be fairly severe, the simplicity which results makes it ideally suited for amateur construction. It requires only one uniselector and four relays, plus one relay for each line. Thus, a 10 line system would require 14 relays.

To some it may appeal as nothing more than an interesting exercise, aimed at providing a practical insight into the elementary principles of automatic telephones.

For school science groups, YRCS or similar radio club groups, such an exercise would be invaluable, particularly as the cost could be spread over a relatively large number of people. A further advantage of such a project is that the end result has a high appeal to those non-technical persons — parents and others — who sponsor the organisation.

Any club which can demonstrate a working model of an automatic telephone exchange which they built themselves, will earn high praise indeed.

But the system need not be limited to a building exercise and simple demonstrations. It has been seriously suggested, by an independent telephone technician who studied it, that it would provide a perfectly practical intercom for a small group of offices.

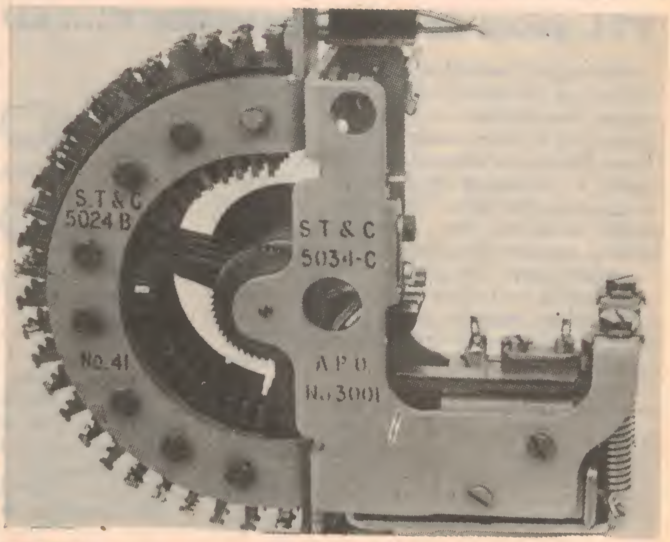
The restriction of one call at a time is not, statistically speaking, as severe as it might appear at first, and compares favourably with similar restrictions encountered in commercial exchanges.

In a typical commercial P.A.X. a group of 200 lines would normally be restricted to handling 11 simultaneous calls, or approximately one call for every group of 18 lines. On this basis one call at a time for a group of 10 lines is not bad odds.

While a call is in progress the remaining phones are simply blocked out of the exchange circuitry. Complete privacy is provided for all calls. Only one pair of wires need be provided for each extension.

Before discussing the operation of the circuit it may be helpful to consider some of the components used in an automatic telephone exchange; components which, in most cases, are only vaguely understood by electronics enthusiasts outside the telephone industry.

Most readers would appreciate that the heart of an automatic exchange is the uniselector or its big brother, the bimotional switch; stepping switches which respond to impulses dialled from the calling phone. But, beyond that, they probably know little about them.



This uniselector is typical of the type which could be used. It has three rows of contacts plus a "homing bank;" the latter just visible at the rear. The coil housing is on the right with the interrupter contacts just above it. Other units may have more banks of contacts, but would be just as suitable.

In greater detail the uniselector could be described as a multi-pole, 25 position switch, stepped by an electromatnetically operated pawl which engages a ratchet wheel. Every time the magnet coil is energised the pawl moves forward and engages one tooth on the ratchet wheel. When the coil is de-energised, powerful springs pull the pawl back to its original position and step the switch arms forward one contact.

The contacts are arranged in a semicircle and there are two sets of moving arms 180 degrees apart. This avoids any need to reverse the stepping action. As one moving arm leaves contact number 25, the other moving arm engages contact number one.

The unit illustrated has three moving arms; two non-shorting and one shorting type. The non-shorting ones are used in this unit, the shorting one being ignored for the moment.

The uniselector normally steps forward one contact at a time, in sympathy with impulses from the telephone dial. On completion of a call it is necessary to reset the moving arms to the "at rest" position, but without the benefit of dial pulses.

For this purpose the uniselector carries its own set of interrupter contacts which generate the required pulses. There is also a fourth switch pole which engages a continuous semicircular contact covering 24 of the 25 positions. The remaining position is a separate contact occupying the "at rest" position. This is called a "homing run" or "homing bank" and the single contact the "home contact."

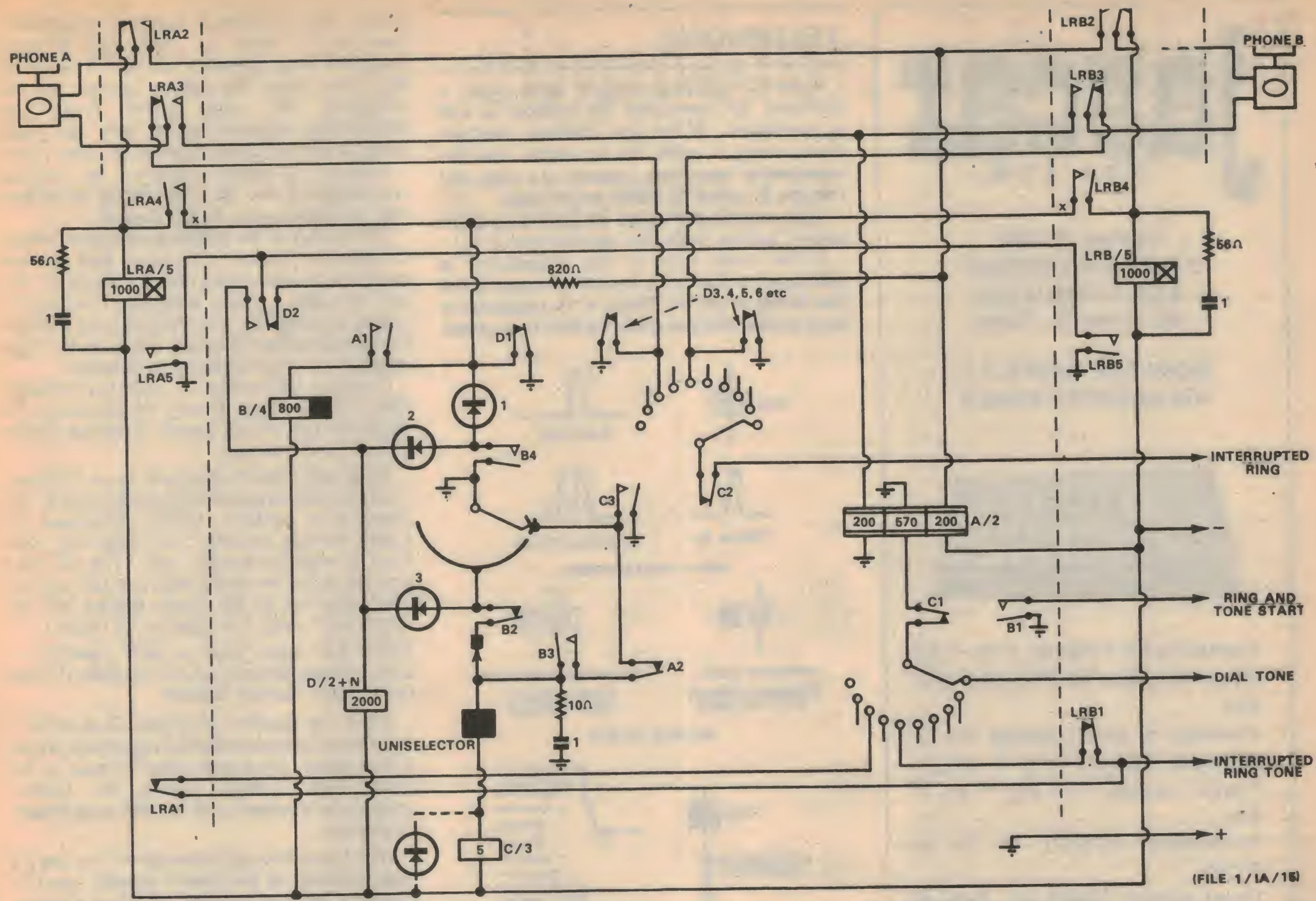
The unused bank of contacts, discussed a moment ago, can also be used to provide a "homing run" by strapping together all the contacts or as many as may be desired. This permits some useful variations on the basic idea, which we may discuss later.

The uniselector coil has a resistance of about 100 ohms and needs at least 40V across it for reliable operation. The interrupter contacts must have a suppressor network across them to minimise sparking, which otherwise would destroy them in a short time. A 1uF capacitor and 10 ohm resistor in series is a typical arrangement.

Most readers will be familiar with relays, but not necessarily with the special types encountered in telephone systems. The main difference is in the response time of these relays. While some are required to operate and release in the fastest possible time, others are required to operate and / or release only after a significant time delay.

While this effect can be obtained in a number of ways, the most common method to date has been to fit a copper slug

* 16 Ellison St, Ringwood, Victoria, 3134



The exchange circuit. Only two phones are shown, designated "a" and "B", but up to 10 can be accommodated. Apart from the line relays (LR) all the components are common to the entire system. One line relay is needed for each phone, but is located at the exchange.

to one end or the other of the relay coil. Such slugs can provide time delays of up to 500mS, although 300mS is a more usual value. If the copper slug is fitted at the armature end of the coil, the relay becomes a "slow operate, slow release" type. If it is fitted at the heel end of the coil it becomes a "normal operate, slow release" type.

Another special type of relay is used in the automatic exchange. This has three windings, two of which are connected in series to provide the normal magnetic field. The third one is magnetically coupled to the other two, and is fed with dial tone or ring tone signals, which are thus magnetically coupled into the telephone circuit. The unit is really a combined relay and simple audio transformer.

Relays having these various characteristics are essential to the operation of the automatic exchange, and they must be kept in mind when studying the way in which it functions.

In the circuits presented here the relay coils are identified by a code letter or letters over a number, the latter indicating the number of contact sets operated by that coil. Thus, "B / 4" indicates that the B relay operates four sets of contacts. The contacts themselves are scattered throughout the circuit and identified as "B1", "B2" etc.

To understand how the system operates, consider first that all telephones are hung up and, as a result, all relays released. In the hung up condition a telephone presents an open DC path, but a closed AC path through the calling bells and a capacitor. (The circuit shows all relays in their "normal" — non activated — position.)

It may also be helpful to point out that, contrary to what one might expect, the uniselector does not switch the speech circuits directly. Its main function is to apply ringing power to the called phone and allow it, and it alone, access to the speech circuits in the exchange.

Assume telephone A is picked up. It now presents a DC path of about 75 ohms and a circuit is completed from the negative supply rail through the relay coil LRA (Line Relay A), contact LRA2, the telephone, LRA3, and the appropriate D relay contact to chassis (positive supply rail).

Close up view of the uniselector coil and terminals. The terminal on the left is common, on the right goes direct to the coil, and between them, at the rear, to the coil via the interrupter contacts.

Note that LRA4 is an "x" contact; it must make first, before LRA2 or LRA3 breaks. LRA locks up via LRA4 and D1 to chassis.

Contacts LRA2 and LRA3 switch the calling telephone across the A relay, connecting the two 200 ohm windings effectively in series and across the power supply. When relay A operates contact A1 completes a circuit through relay coil B. Contact B1 then starts the ring and dial tone circuits. Dial tone is fed via the uniselector home contact and relay contact C1 to the 570 ohm winding on relay A. This relay functions as a transformer and the tone is coupled into the 200 ohm windings and heard in the telephone.

Contact B4 closes and replaces the chassis connection via D1 and simultaneously operates relay coil D via diode 2. Contacts D1, D3, 4, 5, 6, etc all open. Contacts D3, 4, 5, 6, etc are break contacts in each line and, when D operates, prevent any other line from operating its line relay. Relay LRA is already locked up on its own number 4 contact.)

Contact D2 is a changeover set which provides protection against accidental lock-up of a line with resultant loss of privacy. This function will be described later.

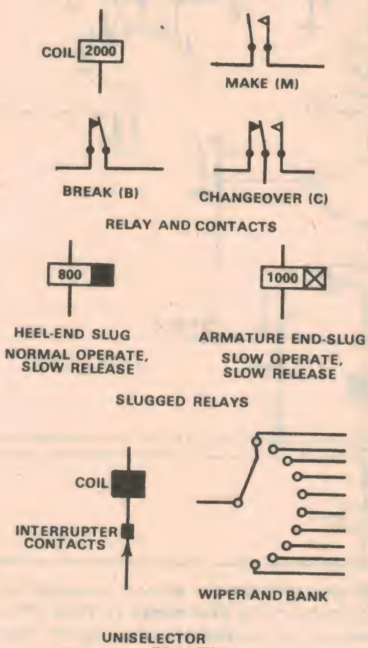
When a number is dialled the DC path through the telephone is opened once per impulse dialled. The A relay opens and closes once per impulse in sympathy. A2 is normally closed but is open prior to dialling, coil A having been energised via the telephone and contacts LRA2 and LRA3.

TELEPHONE

When the dialling contacts open, relay A releases, A2 closes,and the uniselector coil is energised. When the dialling contacts close, relay A pulls in, A2 opens, and the uniselector steps one contact. A1 does not release B, since B holds on its slug.

(The uniselector steps on the removal of power, rather than the application of it.)

At the same time as the uniselector is energised, relay coil C is also energised, the two being in series. Relay C is required to have a slow release time, so that it does not follow the individual dialling impoulses. Instead, it holds in until the dialling sequence is completed. Contact C1 removes dial tone from the calling phone and C2 removes the ring power from the uniselector contacts while they are stepping, to prevent interference to other lines.



Symbols commonly encountered in telephone circuits. Note particularly those for the differing types of slugged relays.

Contact C3 closes, replacing the chassis connection from A2, previously provided via the uniselector home contact.

At the end of the dialling sequence, relay C releases. Contact C1 closes and applies ring tone to the calling phone (phone A) via the 570 ohm A relay winding. Contact C2 closes and applies interrupted ring voltage to the called line (phone B). Now that C3 has opened, no more dialling is possible.

In order that relay C exhibit a suitably slow release time it may be necessary to shunt the coil with a power diode as shown dotted in the circuit.

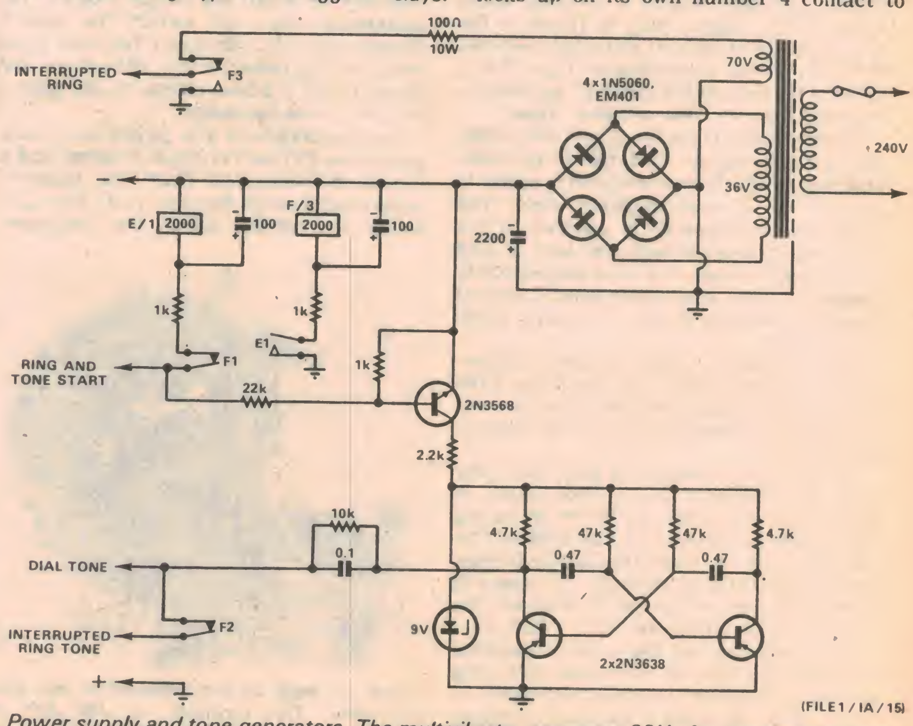
In greater detail the path is as follows: From the interrupted ring supply to C2, the uniselector contact, LRB3, telephone B, LRB2, 56 ohm resistor, 1uF capacitor, and the DC negative supply rail. (The AC ring current is fed in series with the DC supply. The capacitor in the phone blocks the DC component until the handset is lifted.)

Relay LR must have a slow operate — slow release characteristic so that it does not chatter during ringing.

When the handset on phone B is lifted a DC path is completed which operates phone B line relay: from the negative rail to the LRB coil, LRB2, phone B, LRB3, uniselector contact, and via the ring supply to chassis.

(The latter circuit is completed via the F3 relay contact in the power supply, used to interrupt the ring current. This is a changeover set and the ring current line is returned to chassis between each ring. This means that the LRB circuit closes during a silent period between rings.)

When LRB relay for phone B operates it locks up on its own number 4 contact to



Power supply and tone generators. The multivibrator generates 33Hz for ring and dial tone, while relays E and F pulse at the interrupted ring rate. The AC voltages are not critical, nor does the rectified output require a great deal of filtering.

chassis via B4. Contact LRB1 opens, and cuts off ring tone to phone A. Contacts LRB2 and LRB3 transfer phone B from the ring circuit to the A relay. Phone A and phone B are now connected in parallel across the A relay which provides transmission current, so that a conversation can take place.

When the conversation is completed and both phones are hung up, relay A releases, relay B releases. Contact B2 closes and completes the self interrupted drive circuit for the uniselector which drives it back to the home contact. Contact B4 opens and releases both line relays. When both line relays have released and the uniselector is on the home contact, relay D releases and the exchange is back to normal.

One limitation of the circuit described so far concerns a possible loss of privacy. If a telephone user were to give his cradle switch a quick flick it would be possible for his line relay to lock up without operating relays A or B. This LR would remain locked up until the exchange was next used and the locked up line would be able to listen to another conversation.

To prevent this an 820 ohm resistor is connected between LR2 and D2. This allows the A relay to be operated via LR5, instead of via the phone. The sequence is: A "flick" operates LR which locks up via LR4 and D1 to chassis; LR5 operates A via 820 ohm resistor; A1 operates B; B4 operates D; D2 releases A; A1 releases B; B4 releases LR; LR releases D and the exchange is back to normal.

Apart from the exchange proper, it is necessary to provide a basic power supply, a dial and ring tone generator, and interrupted ring current.

The basic power supply calls for a mains power transformer delivering about 35V AC and 70V AC. The 70V AC is used directly to operate the calling bells, while the 35V AC is rectified via a bridge rectifier and simple filter to give about 50V DC. This is used to operate the relays, uniselector etc.

The interrupted ring is generated by a simple pulsing network employing two relays, E and F. These are cross connected so that contact F1 controls power to relay E and contact E1 controls relay F. Each relay is shunted with a 100uF capacitor to provide the necessary time constant. To simplify switching, this circuit is allowed to operate throughout a conversation, even though it is not required.

The ring and dial tones come from the one generator; an astable multivibrator operating at approximately 33Hz. Continuous output provides dial tone and interrupted output provides ring tone. This also operates throughout the conversation.

Contacts F2 and F3 control these functions. Contact F2 interrupts the output of the multivibrator to provide interrupted ring tone and F3 interrupts the 70V AC supply to provide interrupted ring power. Note that F3 is a changeover contact, providing a chassis connection for the exchange ring circuit during the silent period between rings. This is to complete the called line relay circuit as previously discussed.

The voltages specified are not unduly critical. The DC supply could vary from 40 to 55V and the AC from 50 to 80. Note, however, that a 40V DC supply may call for careful adjustment of the uniselector spring tension in some case.

If transformers designed to deliver these voltages are not readily available, it may be possible to improvise with discarded radio power transformers. One suggestion is to use a pair of old 385V-0-385V units working backwards. The whole of the old secondary winding (770V) of one is used as the 240V primary, so that the old 240V primary delivers approximately 75V.

The second transformer is used to deliver about half this voltage. It is used in the same way except that it is connected between one side of the mains and the centre tap of the previous transformer primary winding, and is thus fed with 120V.

The circuit presented in the foregoing is not the only way to make an exchange of this type; it is not necessarily the best way to do it. It is simply one compromise between complexity and performance. As such, it has a few weaknesses which should be considered before construction.

Two or more telephones picked up simultaneously will operate their respective line relays and both will receive dial tone. However, dialling will not be possible and both must be hung up before one can dial normally. The chances of this happening should be fairly remote, however.

Since a parallel transmission feed is used a call between a high resistance line and a low resistance line will result in the low resistance line shunting current from the high resistance line. In practice, this is not a problem with lines under 1000 ohms (half a mile or so).

One phone left off the hook, or one line shorted, will put the whole system out of action.

These problems could be designed out but it was felt that the extra complexity which would be involved would not be justified.

As mentioned earlier, there are some possible variations on this basic design. One

RELAY	COIL	RESIDUAL AIR GAP	CONTACTS	REMARKS
A	200, 200, 570 ohm Hi-z transmission feed coil	Adjustable	M.B.	Must follow dial impulses
B	800 ohm 1½" heel-end slug	Adjustable	M.M.M.B.	Release time approx 300mS.
C	5 ohm May need diode across coil	Adjustable	M.B.B.	Must hold during impulsing and self-drive
D	2000 ohm	.012in	B.C. B per line	A number of relays in parallel may be required to accommodate the contacts
LR	1000 ohm ½" armature end slug or extra winding short circuited	.012in	C.C.M.B.	1 per line required. Must not chatter when line is rung LR4 must make before LR2 and LR3 break

Most of the relay requirements have been covered in the explanatory discussion but the summary in this table may help the constructor select his requirements from what is available. Miniature cradle relays are not recommended (except for D). Use of cradle types throughout would call for circuit changes. The 3000 type relay lends itself to modifications and the units required can be built up from sections salvaged from other relays. An old relay set is a good source of relays, and may also provide a chassis for the exchange.

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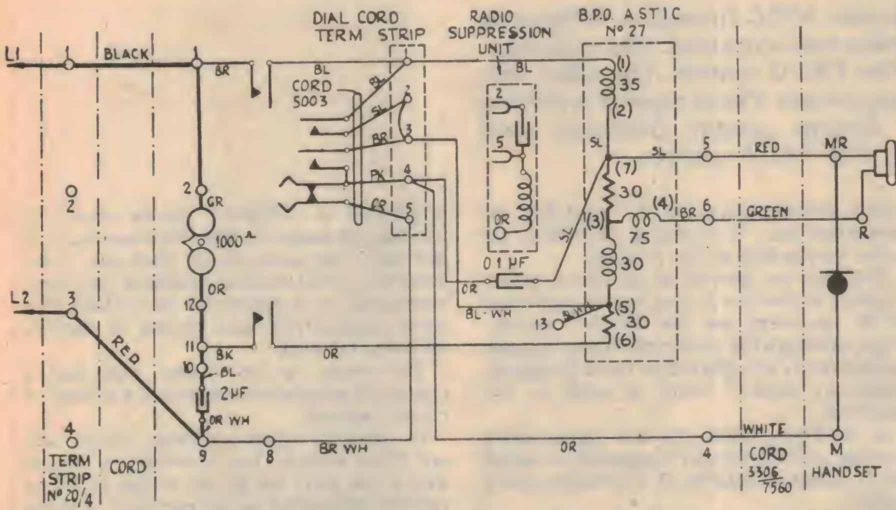
is relatively minor and is aimed at reducing the length of the "home run" on the uniselector, thereby reducing wear and tear.

The other increases the number of extensions to a maximum of 22. Either of these modifications could be made easily after a dial should be satisfactory. Such telephones are offered for sale through disposals outlets from time to time, as are uniselectors, relays etc. Failing that, a search through the Pink Pages of the telephone directory under "Telephone Supplies" may reveal firms who have second hand items for sale.

One point which might require attention in the telephones is the bells. These are normally adjusted to operate on 16 2/3Hz



Circuit of a typical handset as might be acquired through disposals sources. Normally, such a circuit will be found inside the telephone. Although the draughting style may vary, there is very little difference between circuits of the same general class.

the basic unit just described has been completed and tested. We imagine most readers would prefer to tackle the job on this basis if they favour these modifications. We may detail these in a later issue if there is sufficient interest in them.

Incidently, don't try adjusting a uniselector without guidance; they are easily damaged. Ask a telephone technician or, better still, obtain a uniselector adjustment leaflet from the "Publications Sales Office" at the GPO in your capital city.

The telephones themselves require very little comment. Almost any unit fitted with and may not operate properly on 50Hz.

To adjust them for 50Hz it is necessary to provide a shorter stroke for the hammer action. First move the gongs clear of the hammer by rotating them on their mounting bolt (the mounting hole is offset).

An adjustment is available on the magnet assembly which permits the gap between the armature and the poles to be varied. This gap should be substantially reduced so as to shorten the hammer stroke, then the gongs readjusted to suit.

Each gong should be set so that it is just clear of the hammer when the latter is at its extremity for that gong.

Colour Television Systems

Terminology. I and Q signals, U and V signals. NTSC limitations. Differential phase shift. The hue control. The PAL system: basic principles. PAL variations. The PAL-S system and its limitations. The PAL-D system. The délay line. Using the delay line. Adding and subtracting circuits. Phase reversal switching systems. Phasing the reversal switch. Original system. Swinging burst method. Subcarrier interference patterns. The PAL-P system.

In the previous chapter we discussed the evolution of the NTSC colour system, the use of a colour subcarrier, and the method of encoding the chrominance information at the transmitter and decoding it at the receiver.

In this chapter we plan to discuss some of the limitations of the NTSC system, and how other systems.. particularly the PAL system, attempt to overcome these.

First, however, a few final points about the NTSC system in order to clarify some of the terminology the student will inevitably encounter. In our explanation of the colour encoding and decoding process we used the terms B-Y and R-Y to describe the colour difference signals. In practice, these signals will be modified in several ways before actual transmission, and new terms are used to indicate these modifications.

One modification is "gamma correction," which is necessary to compensate for non-linearities in the picture tube light-output-versus-beam-current characteristic. This is done by predistorting (gamma correcting) the camera signal. Gamma corrected signals are often indicated by adding a dash, thus: B'-Y'

Another necessary correction is to modify the amplitude of the chrominance signals after matrixing, but before encoding, in order to avoid overmodulation of the transmitter with some saturated colour signals. This is known as "weighting." (The relative values of the colour difference signals are restored in the receiver before matrixing.)

The NTSC system uses its own particular form of signal processing in order to exploit the eye's natural characteristics to the full. The eye's colour acuity is highest in the orange and blue-green region and lowest in the purple and yellow-green region.

To exploit this the colour difference signals are not strictly B-Y and R-Y. The R-Y signal is shifted in phase by 33 degrees into the orange region and is then known as the I signal. Similarly, the B-Y signal is shifted by 33 degrees in the same direction into the purple region and is then known as the Q signal.

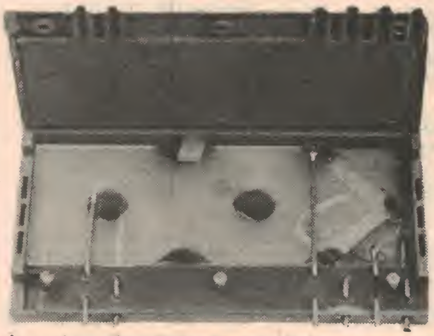
The I signal is allocated the maximum bandwidth (1.3MHz) which can be provided, so that the colours it represents will be reproduced in the greatest detail. The Q signal is allocated a much narrower bandwidth (0.4MHz), which is considered adequate to satisfy the eye.

Unfortunately, the good intentions behind this concept have been largely negated in practice. To extract and present all the information which the NTSC signal contains calls for a relatively complex receiver. It is possible to make a much simpler receiver which actually uses the B-Y and R-Y information but, in so doing, sacrifices the wider bandwidth of the I signal.

This has not proved as serious a disadvantage in practice as was feared, and most NTSC receivers use the simpler system. Thus, although the colour difference signals are correctly designated as I and Q signals, these are seldom used as such in the receivers.

In the PAL system the B-Y signal, after gamma correction and weighting is called the U signal. Similarly, R-Y becomes the V signal.

In any comparison between NTSC and PAL there is a risk of appearing over critical of the NTSC system and those who developed it. This is not the intention, and we should keep in mind the sheer magnitude of the effort needed to produce the first practical system of any kind. And, inevitably, the pioneers paid the usual price for being the first in the field: the fact that someone else very soon finds a better way to do the job.



A modern glass delay line, a vital component in the PAL receiver. The glass plate is clearly visible, and the input and output transducers are at the right hand end. (Philips model PL50 by courtesy of Elcoma.)

The weakest point about the NTSC system is lack of colour stability. This is, perhaps, not really surprising when one remembers that the colour is directly related to the phase of the colour subcarrier; a characteristic which is very easily upset by any one of a number of factors.

But the problem is more than a simple overall shift of phase. After all, if the phase of all components of a colour signal, including the reference burst, are shifted by the same amount, no great harm will result. It is when the phase of the chrominance signal is shifted relative to the reference burst that the colour goes wrong.

One cause of this, particularly in the early days, was simply that programs which originated in different places were not necessarily locked to the reference burst in precisely the same phase. This may have been due to the manner in which they were generated, or to the circuit over which they were passed from one station to another within a network.

The result, to the viewer, was that a change of program often meant a change of colour balance.

To minimise such problems, NTSC sets are fitted with a "hue control;" a control which can shift the phase of the artificial carrier, generated in the receiver, relative to the reference burst. This at least enables the viewer to set the colour balance, at the commencement of a program, to what he feels gives accurate colour presentation. While an inconvenience, it is not an unacceptable one.

Far more serious is the effect known as "differential phase distortion." This is a phase shift — usually in the receiver IF amplifier, but sometimes in a transmission link — accompanying a shift in the luminance level in the picture. Since this occurs only during the line scan period, and not during the reference burst period, the latter is not effected.

The result, to the viewer, is that colours can change as they move from a bright part of the scene to a darker part. This can be minimised to some extent in studio presentations, by avoiding extremes of lighting, but is much more troublesome in outdoor scenes, such as sporting events, where the lighting is no longer under the director's control. Colour films, if not made specifically for TV, can also demand more than the system can deliver.

Fairly obviously, changes of this kind are beyond the ability of the viewer to correct with the hue control. The situation is made worse by the fact that the eye is quite sensitive to changes in colour and that most viewers are quite critical of colours with which they are familiar, such as flesh tones. It is generally considered that a subcarrier phase change as small as 5 degrees produces a noticeable colour shift, while 10 degrees is quite obvious.

In fairness, it must be pointed out that some of these problems have been minimised. Greater standardisation of colour signal generation, plus better quality transmission links, have greatly reduced the differences between programs. But differential phase distortion remains and, so far, no complete solution to the problem has been found within the NTSC system.

It was to overcome these problems that other systems, such as PAL, were evolved. Again one should be fair and point out that a

scheme very like the PAL system was suggested at the time the NTSC system was evolved. After due consideration it was rejected on the grounds of the added complexity and cost which it would involve.

While it is easy to be wise with the benefit of hindsight, it must be realised that the whole economic viability of colour TV was in question when it was being developed; many people in the industry were simply not convinced that the public would ever accept the high cost of even the NTSC system as it was then proposed. As a result, every effort was made to cut costs.

Thus the suggestion for an improved system remained only a suggestion for several years; until, in fact, colour TV was well established in the USA and serious consideration was being given to its introduction in Britain and Europe. In 1958 Henri de France, of France, produced a paper describing what later developed as the SECAM system. About the same time Walter Bruch, of Telefunken A.G., Germany, began developing what was to become the PAL system. By January 1963 he was able to demonstrate the PAL system to the European Broadcasting Union ad-hoc Group on Colour TV.

Before considering the differences between the NTSC and PAL systems it might be useful to consider their similarities. In both systems the colour signals from the camera are mixed in a similar manner to produce a Y signal, a B-Y signal, and an R-Y signal. Both use a chrominance subcarrier modulated in quadrature, and both transmit hue as the subcarrier phase and saturation as its amplitude. Both transmit a reference burst to lock the receiver oscillator in correct phase.

Perhaps the easiest way to describe the difference is to describe the end result in its simplest form, then backtrack to see how this is achieved.

Imagine a colour TV image in which a particular line, due to a phase error somewhere in the system, is portrayed as being excessively blue. Now let us suppose that the next line contains essentially the same information but is made to portray the image as excessively red. If these two lines are viewed from a distance such that they are difficult to resolve as individual lines, then the error of one will cancel that of the other and an accurate colour will be observed.

This, in very simplified form, is the basis of the PAL system. (The letters P-A-L stand for Phase Alternation Line.) In practice there are a number of variations of the system, almost entirely involving receiver design. Thus we have PAL-S (simple PAL), PAL-D (delay line PAL), and PAL-P (perfect PAL), to name three major categories.

As previously explained; the PAL colour difference signals are designated U (nominally B-Y) and V (nominally R-Y), and we will use these terms from now on. To achieve the phase error correction, one of these signals, the V signal, is reversed in phase relative to the U signal and the subcarrier burst, on each alternate line of a field. An electronic switch operating at half the line frequency (7812.5Hz) performs this phase change at the transmitter, and a similar switch at the receiver, operating synchronously with it, restores the V signal to its correct phase on each alternate line.

The point about this exercise is that any phase error introduced into the chrominance signals anywhere in the system will create an error of opposite sense in the V signal on each alternate line. And, since the ultimate colour is a product of the V and the U signals, all colours will be similarly affected. Thus as we previously explained, a signal which is too blue on one line will appear as too red on the next line, the average of the two being correct.

In the PAL-S receiver this averaging of the colour errors is left to the eye, and assumes an optimum viewing condition. Unfortunately, there are limitations to this simple concept. First, note that we emphasised that the phase was switched on each alternate line of the same field. Looking at this another way, we normally regard the interlace system as producing lines 1,3,5, 7 etc on one field, and lines 2,4,6, 8 etc on the next field. The phase reversal will be between 1 and 3, 5 and 7 etc on one field, and between 2 and 4, 6 and 8 etc on the next field.

This means that the same hue error will appear on each pair of lines. For example, lines 1 and 2 may be (say) too blue, while lines 3 and 4 would attempt to correct this by being too red. This pairing makes it difficult for the eye to average the hue error unless it is relatively small, between 10 and 15 degrees, after which the eye resolves each pair of lines separately, giving rise to a "Venetian blind" or "Hanover bars" effect. This is made worse by the fact that the blind pattern appears to drift up or down the picture.

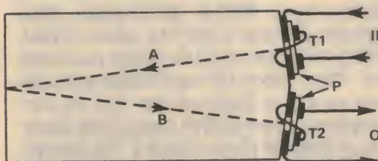


FIG. 4

An early type delay line. G1 is a glass block, T1 the input transducer, T2 the output transducer, and P the piezoelectric plates. A and B show the direction of wave propagation and F is the reflecting face.

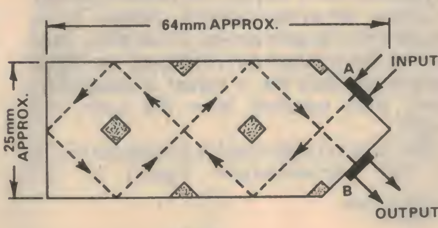


FIG. 5

The present day delay line uses a much more complex reflection pattern and is very much smaller. Note the varnish spots which channel the vibrations.

Thus, while the PAL-S system is an improvement on the NTSC system — in which a 15 degree phase shift is quite serious — its corrective capability is still limited. For this reason, every effort has to be made to minimise differential phase shift within the receiver and this, in turn, can make it more complex and more costly. Since this largely negates the original "simple" concept, most designers prefer the PAL-D system which, although theoretically more complex, is capable of better results and, in practice, may be only marginally more expensive.

At this point the reader may ask why the phase reversal is not made at the field frequency (50Hz), since this would produce opposite error on alternate lines, rather than on alternate pairs of lines. In fact, it appears that Bruch considered such a system, which he tentatively called PAF (Phase Alternation Field), but discarded it in favour of PAL.

The major disadvantage of such a system would be that, while it would improve the performance of a simple receiver, it would not permit development beyond this point. The PAL-D receiver, which is capable of much better results than such a hypothetical "PAF-S" receiver, would not have been possible.

In the PAL-D system the error averaging is performed electronically, and makes no more demands on the viewing conditions than does an NTSC receiver. At the same time it is capable of correcting phase errors as high as plus or minus 45 degrees; errors which, in the NTSC system, produce gross, or even grotesque, changes in colour.

The only adverse effect of phase shifts on the PAL-D system is to cause a slight loss of colour saturation; about 14pc for a phase error of 30 degrees. The eye is not unduly critical of saturation level so this small error is not of great importance. Nevertheless, it can be overcome by using the PAL-P (perfect PAL) system. We will have more to say about this later.

To perform electronic averaging, the PAL-D receiver must be fitted with a delay line capable of storing one complete line of picture information; or a delay time of approximately 64uS. Since it is not practical to provide such a delay using purely electronic circuitry, a mechanical delay line is used.

These are quite remarkable devices and, in as much as the success of the PAL-D system depends upon them, they are worth considering in some detail.

Typically they are made from a block of glass having very special characteristics, particularly in regard to thermal stability. In its simplest form it is a short glass bar with a piezoelectric transducer attached to each end. A chrominance signal in electrical form applied to one transducer is converted into mechanical vibration and transferred to the glass. It travels through the glass, the length of which has been carefully designed so that it takes 64us to reach the other end. Here the second transducer converts the mechanical vibration back into an electrical signal.

A later version of the delay line used a shorter block, the two transducers being at the same end and the wave being reflected from the opposite end. As well as providing a smaller unit, it had manufacturing advantages in that final adjustment of the time delay could be made after the transducers were fitted, by simply grinding the opposite end.

A typical delay line of this type used a relatively large block of glass. A complete unit, with cover, measured about 3cm x 5cm x 13cm and weighed 165g. By comparison, the present day delay line is a miniature device. The Philips DL50 (pictured) measures a mere 7.5mm x 37.5mm x 71mm and weighs 16g.

The reduction is the result of a number of developments. A major one is a much more complex reflection path. Whereas the older unit reflected the signal only once, the modern unit reflects it no less than five times. By this means the same path length can be provided in a much smaller block of glass. Folding the path in this manner does present problems, one being to ensure that

the vibrations are correctly channelled through the glass.

The solution appears to be surprisingly simple; small blobs of special varnish are deposited at critical points on the glass. See photo.) These reduce the transmission coefficient of the glass at these points. They also help control parasitic reflections.

Specifications of the PL50 delay line gives some idea of the high order of accuracy inherent in these devices. The delay time is 63.943us at 4.43MHz, or 283.5 cycles of the subcarrier. The accuracy is plus or minus 5ns. Drift with temperature will not exceed 5ns from +10 to +60 degrees C, and typically is no more than 3ns. Its bandwidth at the -3dB points is from 3.43 to 5.23MHz (1.8MHz) or better.

The high order of thermal stability is achieved by the use of special glass, designed to balance changes in the wave's velocity through the glass with changes in the length of the glass. Thus, if we assume that a drop in temperature reduces the velocity of the wave, the length of the path through which it travels should also be reduced, and by just the right amount to maintain a constant delay time.

(It should now be apparent why the PAF system would not have permitted development beyond the "simple" stage; to do so would have required a delay line with a delay time of one complete field. At the present state of the art such a delay line would be impractical.)

To use the delay line, the incoming chrominance signal is divided, one path being directed to real time circuitry for ultimate decoding and display, and the other path fed to the delay line. (Fig 1).

The real time circuits are further divided, one path going to an adding circuit, the other to a subtracting circuit. The output from the delay line is similarly divided and fed to the adding and subtracting circuits.

Thus the adding circuit is fed with a real time signal and a delayed signal, and the output will be the addition of these two. Since the U signal is always in the same phase from one line to the next, the real time and delayed U signals simply add to produce a U signal of twice the original amplitude. This is then mixed with the subcarrier reference oscillator to produce the U colour difference signal for application to the decoder matrix.

At the same time, adding the V signals has the opposite effect. Since the phase of the V signal is reversed on alternate lines, the V signal emerging from the delay line — being, in fact, the previous line — will always be in opposite phase to the real time V signal. As a result, they cancel and there is no V signal output from the adding circuit.

The subtracting circuit is also fed with a real time signal and a delayed signal, the output being the difference between the two. Since the V signal emerging from the delay line will always be opposite in phase to the real time V signal, the output will be the difference between the two signals, or a V signal of twice the original amplitude. This is mixed with the subcarrier reference oscillator to produce the V colour difference signal for application to the decoder matrix.

At the same time, subtracting the U signals has the opposite effect. Since the phase of the U signals are always the same, subtracting one from the other simply cancels them and there is no U signal output from the subtracting circuit.

Fairly obviously, constructing the V signal from the difference between successive lines, on which it is carried with opposite phase, effectively averages any phase errors introduced anywhere in the transmission path.

For example, a condition which produces a phase error of (say) +15 degrees on one line will also produce a +15 degrees error

simultaneously to the adding circuit, the subtracting circuit, and the delay line. As already explained, the subtracting circuit delivers the averaged, but still alternating V chrominance signal and the adding circuit the U chrominance signal.

The U chrominance signal is fed to the U demodulator where it is mixed with the subcarrier reference signal to produce the U

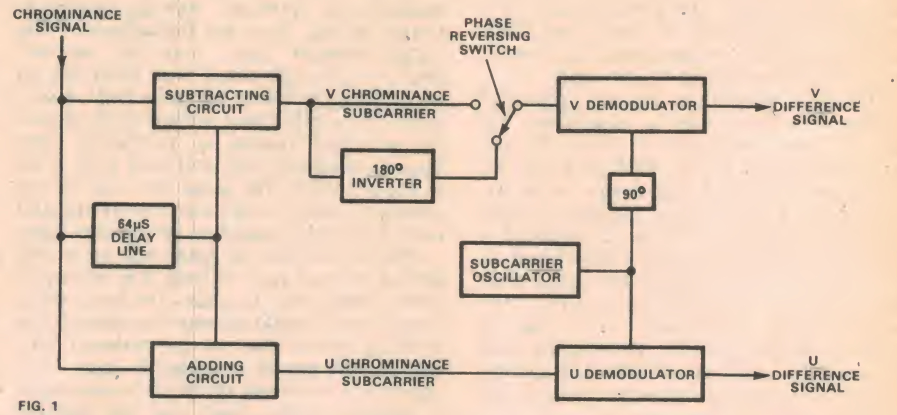


FIG. 1

Fig. 1. Block diagram showing division of the chrominace signal to the delay line, the adding circit and the subtracting circuit. Also shown is one method of phase reversal switching; the V signal is switched before mixing with the subcarrier.

on the next line — except that, because the V signal has been shifted 180 degrees, this +15 degrees will now have the same effect as a -15 degree error, had the phase not been reversed. Thus after the switching process in the receiver, to remove the 180 degree phase reversal, successive lines will have first a +15 degree error, then a -15 degree error, alternately. The average will be zero degree error.

In practice there are two common methods by which the V-signal phase reversal is accomplished in the receiver after the averaging process. In one the chrominance signal — or that part of it used to produce the V signal — is passed through a phase reversing switch before being mixed with the subcarrier. In the other, that part of the subcarrier reference oscillator used to produce the V signal is itself switched. Both methods have the same end result.

The first arrangement is portrayed in Fig 1. The chrominance signal is fed

difference signal.

The V chrominance signal is fed to the V demodulator, where it is mixed with the subcarrier reference signal after the latter has passed through a 90 degree phase shift network, the output being the V difference signal.

Between the subtracting circuit and the V demodulator the V chrominance signal is divided into two paths; one goes direct to the V demodulator and the other goes via a 180 degrees phase shift inverter. The V demodulator switches between these two paths at half the line frequency, timed so as to cancel out the orginal phase alternations.

Fig 2 shows the alternative arrangement. The chrominance signal is fed to the adding and subtracting circuits and the delay line as before, and the U chrominance signal is mixed with the subcarrier mixer as before. The alternating V chrominance signal is now fed directly to the V demodulator, but subcarrier oscillator is now fed to the V demodulator via two phase shift networks;

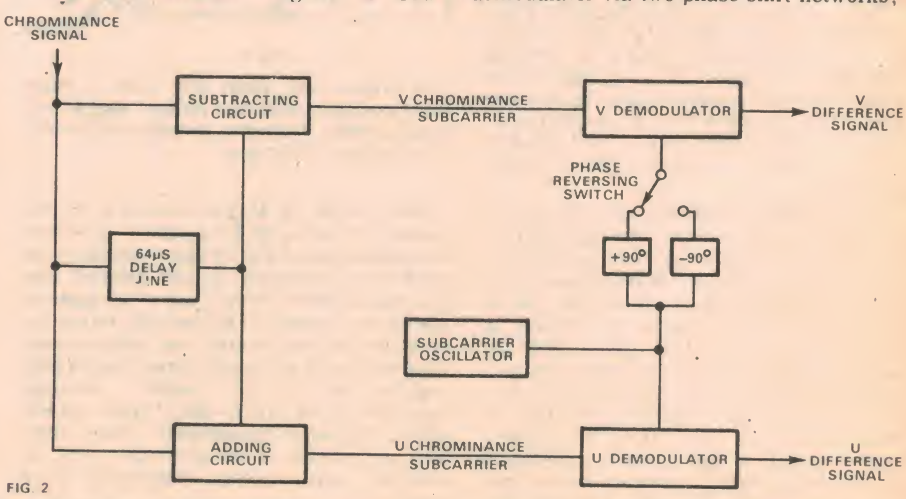


FIG. 2

Fig. 2. Alternative method of phase reversal switching. The subcarrier oscillator is fed to the V demodulator via two phase-shift networks; one giving a +90 degree shift, the other a -90 degree shift. The reversal switch alternates between the two.

one + 90 degrees as before, and one -90 degrees. The V demodulator switches between these two networks at half the line frequency, to achieve the same result as before.

One fairly obvious requirement for any version of the PAL system is correct operation of the phase reversing switch in the receiver. Not only must this operate at exactly half the line frequency, like its counterpart at the transmitter, but it must also operate in correct polarity and phase with the latter.

While the half line frequency could be derived by simple division from the line time base circuitry there is only a 50-50 chance that the phase of such a signal will be correct. If it is not correct the colours will be grossly incorrect: ie, red would become a greenish blue, and so on.

As Bruch originally devised the PAL system this half line frequency was, in fact, derived from the horizontal flyback pulses, but with a potential ambiguity of 180 degrees. This ambiguity was then overcome by transmitting an additional phasing pulse — 7 cycles of a 350kHz signal — during the vertical flyback period. This was suppressed visibly by the normal vertical retrace blanking circuitry.

The modern PAL system uses a different approach, known as the "swinging burst" system. The subcarrier reference burst transmitted at the end of each line is no longer transmitted with the same phase for each line. Instead, its phase is advanced by 45 degrees for one line, then retarded 45 degrees for the next line, and so on.

As far as subcarrier regeneration in the receiver is concerned, this modification is easily ignored. This circuitry is normally controlled by a DC error voltage having a relatively long time constant, and it is not difficult to arrange the circuitry so that it senses the mid point between the bursts which, fairly obviously, will equal a conventional burst operating continuously in the same phase.

On the other hand, the swinging burst can be used both to generate the half line frequency pulses needed to operate the electronic phase reversing switch and also to ensure the correct polarity, thus ensuring that the switch will always function in exact step and phase with its counterpart at the transmitter. The circuitry which uses the swinging burst to do this is usually called the "ident" circuitry, from the fact that it ensures correct identification of the V-chrominance polarity.

Another difference between the PAL and NTSC systems concerns the chrominance subcarrier frequency, and the precautions needed to minimise the interference pattern which it creates in the picture. In this regard the two main requirements were to keep the frequency as high as possible and to ensure that each line contained an odd number of half cycles, so that light areas on one line will fall opposite dark areas on the other line. To satisfy these and other requirements, the NTSC subcarrier is based on the "half line offset."

In more precise terms the half line offset results from multiplying the line frequency by a selected factor (to give the highest practical subcarrier frequency) less one half. Thus the line frequency, 15,734Hz, is multiplied by a factor of 228 less one half, or 227.5. This gives 3.57945MHz as the NTSC subcarrier frequency.

The PAL system is designed to satisfy the same visual requirements, but achieving this is not quite so easy. Because of the phase reversal on alternate lines the half line offset system would result in the light and dark areas of each line being exactly aligned with these same areas on all other lines. Or, looking at it another way, a pattern of vertical lines would be produced by the light and dark areas.

In order to overcome this, two modifications are made to the half line offset concept. First, it is changed to quarter line offset. Second, the line frequency, 15,625Hz, is modified by adding to it the picture frequency, 25Hz. The multiplying factor in this case is 284 (higher because of the greater video bandwidth), so we have 284 less one quarter, 283.75, multiplied by 15,650 which gives 4.3361875MHz as the PAL subcarrier frequency.

negative sign. Therefore, once separated, they are substantially free from phase shift. The -U signal, for example, is now simply a varying amplitude signal exactly in phase with the reference burst (or the mid-position of the swinging burst). The U signal is always exactly 180 degrees out of phase with this, while the V signal will be 90 degrees and (-V) 270 degrees out of phase with it.

If we could find some way of eliminating these fixed and known phase shifts we could reconstitute a reference subcarrier which, at any instant, would be influenced by all the factors which cause the chrominance signal phase to vary and would, therefore, always remain exactly in step with it.

In fact, eliminating these phase shifts is surprisingly simple and a block diagram is

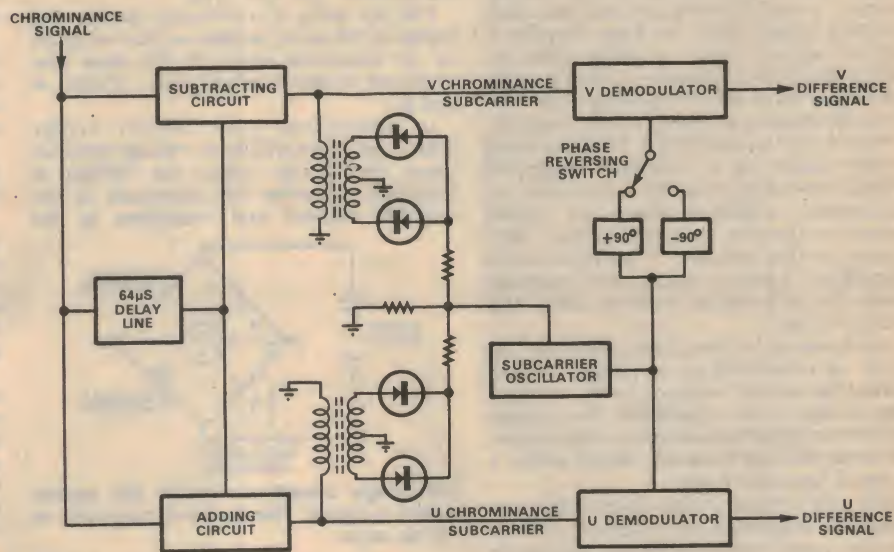


FIG. 3

Fig. 3. Block diagram showing how an accurate subcarrier is generated in the PAL-P system without using the reference burst. The burst is used only to prevent a possible 180 degree ambiguity when the signal is acquired. This can also be done manually.

Earlier, we mentioned the PAL-P, or perfect PAL system. This is interesting for two reasons. One is that the word "perfect" is fully justified, in that it is virtually immune to phase shift effects of any kind. Even the slight loss of saturation which can otherwise occur is eliminated.

The other is that the circuit which it uses, called the chromalock, has been used by local colour TV enthusiasts for a quite different purpose. Because this circuit renders the receiver largely independent of the reference colour burst, they have added it to conventional colour receivers to reproduce, in colour, colour programs (mainly from Britain, on tape) from which the colour burst has been deleted to satisfy Australian Broadcasting Control Board requirements.

The PAL-P system is a logical development from the PAL-D system and its use of a delay line. A by-product of the delay line circuitry and the fact that the V signal is inverted on alternate lines is the fact that the U and V subcarriers can be separated before they reach the synchronous demodulators: something which would not be possible, for example, with an NTSC signal.

As we explained in the previous chapter, these subcarriers are substantially amplitude modulated, apart from the 180 degree phase shift used to denote the positive or

shown in figure 3. First, consider the 90 degree difference between the U and V signals. These signals are picked off immediately following the adding and subtracting circuits, and are fed to simple full wave rectifier circuits, the output of which deliver double the frequency of each signal. And, in doubling the frequency, they change the 90 degree difference to a 180 degree difference.

If, now, we shift one of these signals through a further 180 degrees — by the simple process of reversing the rectifiers in one of the frequency doublers — we have a 360 degree difference — which is no difference at all, the signals now being in phase.

Combining these two signals gives us a signal which is exactly twice the original subcarrier frequency, and which can be used to lock the local subcarrier by any of the simple two-to-one frequency division processes.

The result is a network which not only takes care of the 90 degree difference between the U and V signals, but also the 180 degree shift which either one may experience, plus the regular 180 degree phase reversal of the V signal from line to line.

Thus, while ever there is colour information of any kind being transmitted, involving either or both of the colour difference signals, there will be the means to recon-

(Continued on page 115)

Elementary Electronics

Turn on (almost anything) with a Sensor Switch

by Ross Tester

Have you something that requires switching on when it reaches a certain temperature? Or off? How about when the light level falls — or rises — to a certain level? Or when it gets wet? Or dry? Then this project may solve your problem.

This device is what we call a "sensor switch"; a switch which actuates when any resistive sensor falls or rises beyond a certain pre-set value. A relay pulls in, giving the user the choice of either turning something on or off, by choosing either the normally open or normally closed contacts.

The circuit is basically a level-detecting switch based on a common integrated circuit, the uA741. The 741 is actually an operational amplifier which we talked about in October and November 1971. (Copies of the articles, "The Operational Amplifier" Parts 1 and 2, are available from the information service. File Nos 8 / DT / 49-50.)

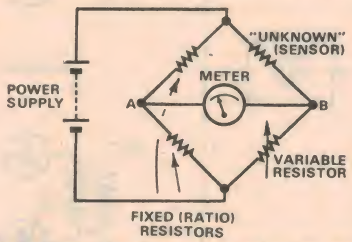
One input of the operational amplifier (op amp) is connected to a voltage divider across the supply voltage. As the op amp has a high input impedance the voltage divider resistors can also have a high value. We used two 10k resistors, which cause a drain of less than 0.5mA.

The other input of the operational amplifier is connected to a second voltage divider, again connected across the supply voltage. This divider consists of a variable resistor and our sensing component. A protective resistor (1k) is included in each leg to limit current in the event of either leg falling to a very low value of resistance.

If you look closely at the circuitry we have just been talking about, you should recognise a bridge. The two divider resistors, the variable resistor and the sensing resistance make up the four legs of a bridge. (For a more detailed discussion on the bridge circuit, see "Elementary Electronics" for May 1972.)

The op amp is connected across the bridge in the same position as that occupied by the indicating meter in the more conventional bridge configuration. (Points A and B.)

In accordance with normal bridge behaviour, there will be no voltage between these two points when the bridge is balanced, ie, when the resistance of the variable resistor and resistance of the sensing device are equal. Under these conditions there would be no output from the op amp apart from leakage current.



The bridge circuit, on which the sensor switch is based. The meter corresponds to the op amp.

When the bridge is unbalanced a voltage will appear between these two points. Its value and polarity will indicate, respectively, the amount of unbalance and the direction of unbalance.

For example: If, in the circuit shown, the resistance of the sensing element should increase, the voltage at B will swing negative with respect to A. This will have no effect on the op amp, the output of which will remain virtually zero.

Conversely, assume that the sensing element resistance decreases. The voltage at B will now swing positive with respect to A and the output from the op amp will increase.

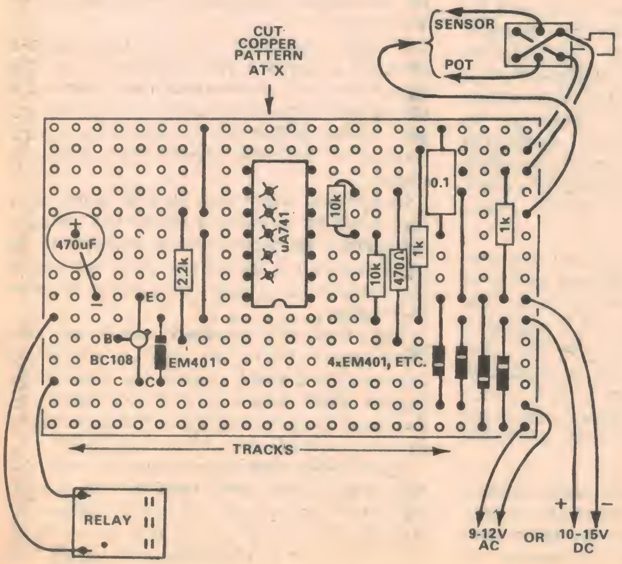
This output can drive a transistor, which in turn operates a relay, which switches on or off whatever device is to be controlled.

We apply AC negative feedback around the op amp, by means of a capacitor connected between the output and the inverting (—) input. This is to prevent the circuit oscillating when the input circuit is close to the threshold voltage, ie, when the bridge is at, or close to, balance.

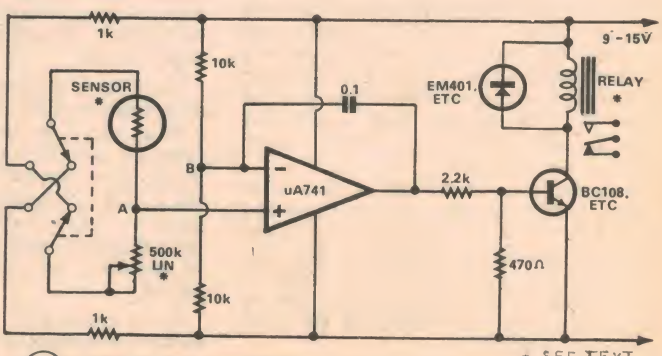
This form of feedback is preferable to a combination of AC and DC feedback, such as would be provided by a resistor. Either feedback system will reduce the gain of the amplifier but an AC feedback circuit can be designed to function only at the higher frequencies, whereas the DC network will function at all frequencies.

While on the subject of gain, a typical figure for the 741 is around 200,000 times — while the worst case figure is still more than 20,000 times.

Since the natural tendency is for oscillation to occur at the higher frequencies, the AC feedback circuit can be made to reduce gain at these frequencies, without affecting gain at the lower frequencies where a circuit of this kind will normally be required to operate. The feedback is thus made selective — it functions only where it is required.



These three diagrams are all that should be needed to construct the Sensor Switch. Note the orientation of tracks on the Veroboard, and the 5 cuts to be made. Also note that unmarked pins on the base diagrams are internally connected, and should not be connected to other parts of the circuit.



SENSOR SWITCH (FILE 3 / MS / 47)

Now let us reconsider the input circuit — the bridge. As it stands, the circuit can be used to sense any change which causes a device to change resistance. A common device would be a light dependent resistor (LDR) which can be used to sense a change of light level.

An alternative is the phototransistor, these having the advantage of a much faster "rise time". In other words, the phototransistor changes value virtually instantaneously as the light level changes; an LDR may take tenths of a second to do the same (or even seconds at low light levels). While not important in some applications it can be important in others.

Another simple device which can be used directly with the circuit is a thermistor; a resistor which changes its resistance as its temperature changes. There are many types of thermistors, suitable for a variety of roles.

Some thermistors have negative temperature coefficients (resistance falls as temperature rises) and others positive temperature coefficients (resistance rises as temperature rises). NTC thermistors are the most common, and would be the better choice.

Ask your parts supplier for an NTC thermistor, which has a 20 degree C resistance of around 50-100k. There are many thermistors which fall into this category.

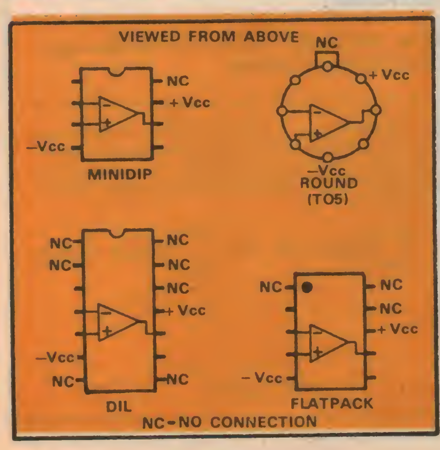
Another "sensor" is a piece of "Veroboard" with alternate tracks connected together. This can act as a rain alarm — or, by careful setting of the potentiometer, as a "dry" alarm as the Veroboard dries off.

Other applications for similar types of moisture detectors (such as a garden moisture indicator) may suggest themselves to readers.

The TGS Gas Sensor described in the June issue can also be used. As then, the heater has to be connected to a source of low voltage at reasonably high current but the astute reader could no doubt overcome this problem.

The potentiometer used as the balance control in the bridge is not critical, but there is one proviso. As it must be able to balance the bridge, and the ratio resistors are equal in value, the pot must have a maximum resistance equal to, or greater than, the maximum working resistance of the sensor. We have specified a 500k linear in the parts list, but if phototransistors are used, this should be increased to, say, 2M Lin. Linear types give easiest control.

A power supply is shown, but this need not be used. The circuit works quite happily from a 12V battery. The supply as shown gives approximately 14V DC out.



In some circumstances it may be desirable to have the relay remain pulled in after it has been activated — for example, when it forms part of a burglar alarm circuit. There is not much point in having an intruder pass through a light beam, and trigger a relay, if the alarm bell rings for only a fraction of a second.

There are two easy ways to overcome this difficulty. One is to use a pair of contacts on the relay as a latch — as soon as they close, they bypass the transistor and hold the coil energised. There may be objections to this — the most obvious being that the relay may have only one set of contacts.

The alternative is to use a small SCR (silicon controlled rectifier) in place of the transistor. This latches on by itself, freeing relay contacts for other uses. Low power SCRs (2SF106, etc) are now commonly available for little more than the price of an equivalent transistor.

Most types should directly replace the transistor — gate for base, anode for collectro and cathode for emitter. However, in the event of low gate sensitivity, one resistor may need to be changed.

Increasing the value of the 470 ohm resistor will provide more drive, thus catering for lower sensitivities.

Once such a system is latched up, by whichever means, it will remained latched until it is deliberately unlatched; usually by turning the whole system off. This may be done manually or, with some added complication, by means of a time delay circuit.

If space permits, next month we plan to show a couple more "sensors" for the switch, which will enable it to be used for other phenomena, plus a few other circuits showing a 741 in different modes.

The 741 is available in several packages. The one we used is a standard DIP (dual in-line plastic) with 14 pins. Also available is a mini-DIP (8 pins), a 14 pin ceramic or metal cased DIL, a 10 pin flatpack, and an 8 pin TO5 (round) package. There is nothing to stop you using any of these packages — internal connections are shown for all. The basic arrangement of the connections is roughly the same for all packages.

The sensor switch is laid out on 0.1in matrix Veroboard. This is ideal for the job, as the DIP IC pins are spaced 0.1in apart. A certain amount of "knife and forking" is necessary if the relay is to be mounted on the board, including drilling larger holes between the normal holes.

In fact, some types of relay are not suitable for mounting on the board at all. In this case, leads can be run from the relay coil to the respective positions on the board. There are a number of different types of relay, with varying contact ratings. We imagine that readers will use the one most suitable for their application. Make sure, however, that the relay will pull in with a voltage less than 10.

One type of relay which we have used is the Siemens V23016-A005-A101. This has a slot arrangement for mounting, intended to go over the head of a screw, and has contacts rated at 240V, 7A. Its one disadvantage is that it has only one set of changeover contacts. A number of other relays, by Siemens and others, also have contacts with fairly heavy current ratings.

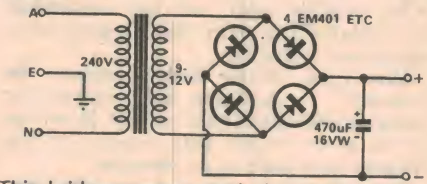
Solder all components to the Veroboard except the IC, which should be left until last. An IC socket is recommended, especially if you plan to use the 741 for any other purpose. ICs are particularly difficult to

ELEMENTARY

remove once they have been soldered in place. Apart from mechanical damage, there is a risk of heat damage.

Extreme care must be taken when soldering to 0.1in Veroboard, especially around the IC pins, as it is very easy to flow solder between the tracks. At best, this will stop the circuit working properly; at worst, it could be disastrous for the IC and other components.

There are five cuts to be made in the copper pattern between the pins of the IC. These are easiest made with a twist drill — about 3/16in or so. The copper should come away cleanly. Make sure that there are no copper bridges around the hole, or between tracks.



This bridge power supply is quite suitable for the sensor switch. Output voltage depends mainly on transformer secondary voltage.

Mounting arrangements for the board, relay switch and sensor are left to the reader. Some may wish to mount them inside a box for safety — this is recommended if a mains supply is to be used. Also on the safety angle, the relay terminals should be shrouded properly if mains voltages are being switched.

It is preferable to have the relay coil energised for the greater part of the time the circuit is in operation. This is especially important if batteries are to be used, as a relay coil has quite a heavy drain. If, for example, the circuit is being used as a light beam alarm, the relay should only be energised when the beam is cut. Therefore, most of the time (presuming there aren't too many intruders!) the photocell is illuminated, holding the op amp output at minimum.

In the event that opposite circuit operation is required (for example, a daybreak monitor or a safe alarm where the normal state is dark and light triggers the circuit) we have provided a changeover switch so that, once again, the relay coil is energised for the least possible time. In this case, a dark photocell holds the output down and an illuminated one allows it to go high.

We used a McMurdo push-button switch for the changeover function, but any 2 pole changeover type switch could be used. The switch is wired so that in one position the sensor connects to the positive rail and the variable resistor to the negative, while in the opposite position, the connections are reversed.

A diode must be placed across the relay coil to protect the transistor. During switching, quite high voltages are generated across the coil — and these could easily damage the transistor. The diode shunts these voltages, preventing them from reaching the transistor.

The relay we used draws around 65 milliamps in the energised position, which is quite within the capability of a BC108 or equivalent transistor. The relay coil becomes quite warm after prolonged operation — another good reason for making the relay normally off.

Elementary Electronics Ideas Worth Trying

Using diodes

Here are two useful applications for low cost diodes. The first concerns dial lamps.

Dial lamps in radio and TV sets often burn out prematurely if operated from the full filament supply voltage, but will last a lot longer if the voltage is slightly reduced. This can be done with a resistor, but resistors have several disadvantages. A unit of suitable value is not always available, home-made substitutes are often unsatisfactory or difficult to support, and the voltage across them varies as the current varies.

This latter point is particularly important where there is more than one lamp on the same circuit. If one lamp fails the remaining lamp(s) will have an increased voltage applied. Also, as lamps age, they tend to draw less current, increasing the voltage across them.

A better approach is to use a low voltage silicon power diode in place of the resistor. These are cheap, compact, and maintain a virtually constant voltage drop regardless of typical current variations. Although one will usually provide sufficient drop (0.6V) two or more can be used in series if necessary.

The second suggestion concerns LEDs used in experimental circuits.

A protective network for LEDs can be provided by connecting one diode across the LED in opposite polarity, and four diodes in series across the LED in forward polarity. The reverse diode will protect in the event of a reverse voltage being applied, and the forward diodes will limit the maximum voltage of correct polarity.

(Mr D. Halterman, PO Box 674, Geelong 3220)

Probe housing

In planning to build one of the signal injectors described in "Electronics Australia" I had difficulty in obtaining the case specified and, in any case, these are fairly expensive.

As a result I built my unit in a discarded IF transformer can; one of the round variety with two bolts riveted to the bottom. These bolts were used to hold a circular piece of matrix board on which is mounted the on / off switch.

The probe was made from a machine screw filed to a point and insulated from the can with a fibreglass moulding.

The multivibrator was built on a small printed wiring board, the back of which was covered with insulation tape to insulate it from the metal case.

(Mr G. Bird, 6 Apex St, Naremburn 2065.)

Solder wick

Instead of buying solder wick, I have been stripping the insulation from any multi-strand wire such as household flex, figure 8, hookup wire, etc, and twisting the strands together.

I then dip the wire in conventional flux made from resin dissolved in methylated spirit. I find this very cheap and effective — it soaks up solder like blotting paper!

(Mr G. Scott, 30 Mitchell Rd, Mont Albert 3129.)

(Editorial Note: While this is not a new idea, we felt it deserved inclusion for the novelty of using conventional wire for the wick instead of copper braid.)

A new section next month

This is our last "Ideas Worth Trying" page for the time being. It seems that readers have run out of ideas. In its place we are planning a new section; one which we believe will be just as popular.

It will be called "How Does It Work?" and in it we hope to answer the question which we feel sure readers have asked themselves about the things an average person takes for granted: Just how does it work?

Things like fluorescent lights, lifts, traffic lights, telephones, batteries, etc, etc . . . The list goes on and on.

If you have ever wondered how something worked, drop us a line and tell us about it. We won't be able to acknowledge your letter — but your query will go on file — and when space permits, we will print your question and an answer.

Send your letters to: How Does It Work?, Electronics Australia, Box 163, Beaconsfield, NSW 2014.

Classical Recordings

Reviewed by Julian Russell

Boulez plays Boulez — "most significant"

BOULEZ PLAYS BOULEZ — le marteau sans maitre. Yvonne Minton (mezzo-soprano) and the Ensemble Musique Vivante.
Livre pour Cordes. Strings of the New Philharmonia Orchestra. CBS Stereo No SBR 235606.

Since Pierre Boulez is perhaps the most often discussed composer working today, this might be a good opportunity to discuss him and his music because very little of the latter is ever heard in Australia.

By way of preliminary I had better mention that the work under Review, "le marteau sans maitre" — it's Boulez' idea to start off with a lower case l — dates back originally to 1954 with a revised edition published in 1957. So it's had 20 years to grow on the public.

One might be forgiven for thinking this is ample time in which to win public approval or else be forgotten. It receives a very occasional performance, during which the average member of a concert audience listens to it blank eyed, bewildered or just angrily. It is, of course, greeted with dutiful enthusiasm by the coteries to whom it is the "in" thing.

This is in no way meant to disparage the courage of CBS in making the excellent performance available for unlimited study to those determined to find out what it's all about. The company deserves the gratitude of every student of contemporary music.

But before we go on to discuss the music, first something about the man himself: His portrait on the record sleeve shows him to have become much plumper in the face than when I saw — and spoke to him — some 10 years ago. Then he looked very much like a French minor public servant, though only a moment's conversation dispelled that illusion. For a description of the man himself I am indebted to Robert Craft's admirable annotations that accompanied the 1961 Philips record of "le marteau." Back in 1961, Craft wrote:

"A short man growing slightly stocky, bald, Napoleonic. Can drink four framboises (a potent French raspberry liqueur J.R.) after dinner with no decline of intellectual focus. Never eats breakfast. Is generous with money. (He is rumoured to have plenty of it without having to work. JR.) Could organise and run even the French government. Was a choirboy. Is without religious beliefs. Squashes sceptics by being able to "do it himself" (eg play it on the piano, conduct it.) Possesses a phenomenal ear. More attracted to Oriental and Indian culture than to Italian and Greek. Is greatly interested in Psychological method. Has nervous blink. Doesn't date letters and has the tiniest handwriting in Europe (the German radio stations keep special secretaries with magnifying glasses to deal with his correspondence.) Sleeps five hours. Is never ill. Holds down three or four commissions at a time by sending a movement to each."

There is more about where and how he lived in Paris but shortly after Craft wrote this illuminating miniature, Boulez went to live in Baden in Germany where, for all I know, he may still live. That's the man and anything less like a French minor public servant would be hard to imagine.

Craft goes on, in a long and perceptive article, to trace the composers who influenced Boulez, though he is careful to make it clear that these are only "possible clues to orientation, not as points of departure." Craft goes on to state that "le marteau" is a connecting and tradition-forming work that brings together two or three diverse strands. To read further on this subject I suggest you somehow get hold of Craft's article. There is no space here to trace these developments with as much detail as Craft does.

In form, though in little else, "le marteau" resembles Schonberg's Pierrot Lunaire — a few short pieces interrupted by vocal items. You, even if you are experienced in such matters, will find it difficult to follow with a score, which can be obtained from Universal Edition (London) Ltd, London. But to help you do so you may find Benjamin Folkman's sleeve notes on the new CBS issue more helpful than the much fuller ones by Craft. Craft's notes are directed at those who have taken a course in avant garde jargon. Folkman's make no such demands and may be easily understood by anyone of reasonable musical intelligence.

The words of the vocal items are by the French surrealist poet Rene Char and could be made to mean anything to anyone, including Boulez himself. It's not even clear if they mean anything at all, again even to Boulez except for vague surrealist associations.

Boulez' music is ferociously difficult to sing or play, and is becoming more difficult as he grows older. Indeed there has long been a rumour that his latest pieces are too difficult for all but the most skilled musicians to tackle and that Boulez has ceased composing to concentrate on conducting, at which activity he is often very good indeed. I recall hearing in Vienna during the 1960s two short pieces, Improvisations sur Mallarme, excerpts from a work in progress, Pli selon pli, which has since been issued on disc, that took the well seasoned Vienna Symphony Orchestra so long to rehearse under Boulez himself that another item on the program had to be deleted, because no further time for rehearsal remained available.

Now it seems to me that music that needs so many rehearsals deserves a similar listening period by an audience. The original Philips recording of "le marteau" had 14 rehearsals for about 35 minutes of music. "le marteau sans maitre" means in English "the masterless hammer" and I admit, without any bashful reserve that if I had to listen to it 14 times straight off it would fell me as surely as Wotan fells Hunding in The Valkyrie. Perhaps your patience might stretch further. If so, good luck to you.

Another point: the amount of study a conscientious — and superbly competent — conductor would need to prepare the work before even facing his orchestra would surely deter even the most courageous. And even allowing for such talent and industry could he even then be sure at all times that the musicians were playing the right notes? I doubt it — and, please excuse my cynicism, would this matter?

Now I am aware that anything I might write about "le marteau" in words of praise would be preaching to the converted. Other readers might well fill the "Electronics" mailbag with impolite letters addressed to me. Avant garde music might be said to have been born to the Second Vienna School — Schonberg, Webern and Berg — in pre-World War I days. That makes it over 60 years old. And if we exclude that outstanding genius, Alban Berg, how much of it receives performance today, except to the coteries mentioned above?

An enormous amount of industry goes into the creation and production of an opera and new ones make their appearance every year. But how many survive? And if they do, how many are included in the permanent repertoires of the world's great opera houses? Wozzeck, most certainly, though it has not yet found its way to Australia. The same composer's Lulu, perhaps it seems to me, because its present success is built on the spectacular difficulty of its title role and the eroticism of its libretto rather than on the attraction of its music. And these operas are over a half century old.

I can think of none other today that have remained for any significant length of time in the repertoire. And the same might be said of this music in its other forms, solo and orchestral, though orchestral today means something very different from what it did only 50 years ago.

Where then is music going today? I don't think anybody at any period has been able to answer that question successfully. And every innovation has had not only its critics but its bitter enemies. It's not so long ago that some of Mozart's music was described as cacophonous. That great genius Richard Wagner complained all his life of lack of success and it is true that he had his struggles. But he always found somebody at the last moment to come up to scratch with the funds necessary for him to live and work comfortably.

And as to his lack of success, how many other composers have been successful enough to have a theatre built during their lifetime in which his works, and his works only, were to be performed? I am referring, of course, to the Wagner Festspielhaus at

Bayreuth in Bavaria. But though Wagner during his lifetime was not without his many detractors his works were constantly performed and endlessly repeated to rapidly growing acceptance. Today they are perhaps the most firmly established works in any opera house with the means of producing them.

How much avant garde music, after 60 years of development, has the same durability? I can literally count the works on one hand. And this during a period when the world is filled with music, wanted and unwanted, in hotels, lifts, coffee shops homes and other countless places. Music good, bad, and just banal. Personally I will be convinced of the general acceptance of avant garde music when I hear an avant garde national anthem!

And all this leads me to these points: was the production of this record a waste of time? By no means, and its production reflects great credit on the enterprise of CBS. Should you buy it? My answer to that is that if you want to find out what has been going on recently in the development of music, its acquisition is a must. Will you enjoy it? I wish I knew the true answer to that one!

I can recommend its production characteristics and its performance. It is getting more than a fair chance to make its own way. And I have spent this unusually long time in telling about it because in my opinion it is perhaps the most significant disc to be produced in many years.

★ ★ ★

ROSSINI — Overtures to William Tell; The Thieving Magpie; Il Signor Bruschino; The Siege of Corinth; The Barber of Seville; and The Silken Ladder. Ace of Diamonds Stereo. No SDDA 392.

Ace of Diamonds discs are usually reissues put out at a reduced price. This disc is an exception. It is not only new but is also issued at a budget price.

As might have been expected Gardelli wins sparkling playing from the New Philharmonia, though the sound is not always out of Decca's top drawer. Most of the overtures will be well known to record buyers. But there is one exception the Siege of Corinth Overture, which I myself heard on this disc for the first time. Briefly I would describe it as less sparkling than characteristic Rossini, but more seriously developed. It is magnificently orchestrated and its worthiness of preservation goes far beyond any reasons of sentiment. When one remembers the current enthusiasm for such Rossini operas as The Barber of Seville and Cenerentola, one is inclined to wonder why a "first time" issue like this appears for Ace of Diamonds. Perhaps the keen Decca ears were slightly disappointed with the sound. This, however, does not prevent it from being a rare bargain.

★ ★ ★

TCHAIKOVSKY — The Nutcracker. Complete Ballet. Orchestra of the Swiss Romande conducted by Ernest Ansermet. Ace of Diamonds Stereo No. SDDA 378 / 9. (Two Discs).

Unlike the Boulez work reviewed above this should appeal to all tastes, high—, middle— and lowbrow. It should delight everyone but the tone deaf. First issued at full price about 15 years ago it now comes at a reduced price under the Ace of Diamonds label. It is, near enough, a complete recording of Tchaikovsky's enchanting score and the sound bears up very well, all things considered.

Ernest Ansermet spent many years of his busy and distinguished life as chief conductor of the Diaghileff Russian Ballet so that judgment of tempos will be just right for all those who know the music from ballet performances. Moreover the orchestra plays with such graceful enthusiasm that a rare miss of ensemble goes almost unnoticed.

Those who know Nutcracker only from the popular suite, still a favourite in every Palm Court in the world, will be literally astonished at the flood of melodies that go close to engulfing one from beginning to end.

Tchaikovsky was one of the world's greatest melodists and the extent of his invention in this one ballet comes very close to incredible. There is not a banal note in the whole entrancing score. If you want to sit back and be charmed out of the grumpiest possible mood, this is most certainly for you. I recommend it with all enthusiasm.

★ ★ ★

SCHUMANN — Kinderszenen. Piano Sonata in G Minor. Wilhelm Kempff (piano). DGG Stereo No 2530 348.

Wilhelm Kempff confers on the Scenes of Childhood and the G Minor Sonata the wisdom and dignity of his advanced age. He is in his middle 70s. And if in the process the music loses some of the rashness one associates with Schumann, it gains in Kempff's steadiness of control. I always think of this type of Schumann's music in terms of Artur Rubinstein who although older than Kempff (I think) still retains a wonderfully youthful outlook on these charming pieces. Don't look for the same apparent innocence in Kempff's reading. The only movement in which he indulges in Rubinstein's seemingly artless impulsiveness is in the Finale of the sonata and, in my opinion, this is his least successful movement. To describe it as fussy would perhaps be too unkind. Perhaps too consciously pretty might be a fairer comment.

The Scenes of Childhood are not meant to be descriptive of kids' activities, nor were they conceived to be played by mere youngsters. Rather they meant to be an adult's recollections of childhood events. In this suite I am afraid that Kempff lets one down with a bump. Always an earnest musician the spirit of these little pieces seems to entirely elude him. Somehow I cannot imagine him ever having been anything but a very solemn little boy though here I may be quite wrong. But whatever he was like, at his present age his memory seems to have grown very faint. The sound is full and generous, which is more than can be said for the playing time of the disc.

Variety Fare

Reviews of other recordings

Devotional Records

THIS IS HARRY SECOMBE. Volume 3. Immortal Hymns. Stereo, Philips International Series 6414356.

After so much air play over the last couple of years, the powerful voice of Harry Secombe should need little introduction. Powerful? Some perhaps might consider it somewhat overwhelming, when heard through an entire album. But in the present volume 3, with organ and choir directed by Wally Stott, he is more a featured singer than a solo artist, and any reservations along the lines above should largely be dispelled.

The title "Immortal Hymns" is entirely appropriate: All Hail The Power — Praise My Soul The King Of Heaven — Ride On In Majesty — Holy, Holy, Holy — Rock Of Ages — All People That On Earth Do Dwell — Onward Christian Soldiers — Jesu, Lover Of My Soul — Lead Kindly Light — Christian Dost Thou See Them — Our God Our Help In Ages Past — Abide With Me.

Quality is good and, if you have a place in your collection for these immortal hymns, sung straight, this album at $3.98 is good value. (W.N.W.)

★ ★ ★

OH HAPPY DAY. The Edwin Hawkins Singers. Stereo, Buddah Records (Phonogram) 2359-022.

How do you react to negro style Gospel with its mixture of jazz, up-tempo, sustained choruses and heavy emotion? You don't like it? Then there's no way you'll appreciate this album by the Edwin Singers!

On the other hand, if it is your scene, they'll bring you a generous program of negro style numbers: O Happy Day — He s A Friend Of Mine — Just A Closer Walk — Listen To The Rain — Jesus — He's Got The Whole World In His Hands — Footprints Of Jesus — Blowin' In The Wind — Let Us Go Into The House Of The Lord — Lay Down.

The quality and stereo spread is good and, if you like the music, over 40 minutes of it for $3.98 is good value. (W.N.W.)

★ ★ ★

PAT BOONE and the First Nashville Jesus Band. Stereo, Lamb & Lion LL-1004. (From Sacred Productions Aust, 181 Clarence St, Sydney, and other capitals.)

Having spent most of his boyhood in Nashville, Pat Boone professes to be completely at home in a local recording studio and with the Nashville style vocal and instrumental backing. The style is pleasantly rhythmic C&W with subdued touches of bluegrass that will please many and offend none.

The titles: I Saw The Light — Family Bible — My Religion's Not Old Fashioned — Wait A Little Longer. Please Jesus — Are You Walkin' and A-Talkin' For The Lord — The Great Speckled Bird — Me And Jesus — Taller Than Trees — Wait For The Light To Shine — Tramp On The Street — Turn Your Radio On — Avenue Of Prayer.

A fully imported album, it carries a portrait of Pat Boone on both sides, which should please his fans. The sound quality is good and, all round, it should be a very acceptable family Gospel album. (W.N.W.)

Instrumental, Vocal and Humour

BURT BACHARACH, LIVING TOGETHER. A&M L35021. Festival records release.

A mixture of vocal and instrumental renditions of some of Burt Bacharach's own compositions give pleasant listening on this record. He shows his multi talents by not only leading the orchestra and playing the piano on all tracks but fills in with some of the vocals as well.

The titles are: Something Big — Monterey Peninsula — I Come To You — Walk The Way You Talk — The Balance Of Nature — Living Together, Growing Together. — Reflections — Lost Horizon — Long Ago Tomorrow — I Might Frighten Her Away.

The quality is excellent, with good use made of stereo, my only complaint being that some of the numbers have the feeling of over-production, as if they were meant for some TV spectacular. A lot of simple melody lines can suffer this way. (N.J.M.)

HAWAIIAN GOLD. Tennessee Guitars. Quadraphonic, SSS (Festival) LQ-35009.

Marry traditional Hawaiian sound and melodies with the Nashville scene and you have this album — Hawaiian steel guitars producing the melody line, backed with rhythm and an occasional touch off waa-waa.

The titles: Hawaiian War Chant — Little Grass Shack — Pearly Shells — Sweet Leilani — Blue Hawaii — Shangri-La — Aloha Oe — Hawaiian Sunset — Hawaiian Wedding Song — Coconut Grove — White Silver Sands.

The sound is clean and the 4-channel treatment spreads the musicians around you, which is appropriate for this atmospheric type of music. If you like steel guitars, this one could be for you. If not . . . (W.N.W.)

★ ★ ★

THE SCHOBER THEATRE ORGAN. Jim Ramsey. Stereo, Schober SOC-11. (From Schober Organs (Aust), 124 Livingstone Ave, Pymble 2073. $5.95 posted.)

One-time theatre and radio organist, Jim Ramsey has been Director of Customer Relations with the Schober Organ Corporation for the last nine years. On this album he sets out to demonstrate the capabilities of the Schober 2-manual Theatre model — actually the instrument installed in his own home.

He certainly makes his point: the organ can produce sounds strongly reminiscent of the old-time pipe Wurlitzers and Jim Ramsey knows how to invoke them, as he plays a pot-pourri of titles: Deep In My Heart — I'm Sitting On Top Of The World — Brown Bird Singing — Whatever Lola Wants — How Green Was My Valley — Largo — Gold Mine In The Sky — Largo — Exactly Like You — Menuet — Traume — Love Story — Sunday — Prelude In C Minor — When The World Was Young — Tzena, Tzena, Tzena — Deep Night.

If you're wondering how a Schober build-it-yourself organ could sound in your home, this record will show you — and that is its prime purpose. But, as an organ record in its own right it may not represent the best way to spend $5.95. The reason, I think, is that the acoustic environment of a home cannot compete with a professional studio situation or an actual auditorium. As can so easily happen, the big sound of the organ is stifled by the limited acoustic environment.

An album that will be of interest primarily to owners or would-be owners of a Schober organ. (W.N.W.)

★ ★ ★

DANCE WITH THE MOM AND DADS. GNP CRESCENDO L35060 Festival release.

With Mom on piano and the rest of the family on percussion, accordion and saxophone, you immediately get the sound of an old-time local dance at the Mechanic's Institute or the nearest wool-shed hop.

If you like the old-time sound, the titles on this record may tempt you to spend. The tracks are: Tennessee Waltz — Sweet Georgia Brown — My Happiness — Have I Told You Lately That I Love You — Over The Waves — Yes Sir That's My Baby — Moonlight On The Manitoulin — Redwing —Who's Sorry Now—You Call Everybody Darling — Wabash Cannonball — Amazing Grace.

If the titles appeal you will find the quality good. (N.J.M.)

★ ★ ★

TUBULAR BELLS. Mike Oldfield Virgin Records L 35127. Festival Release, Stereo.

I'm at a complete loss to categorise this record, except to say, if you were given the task to find a record that contains the widest range of musical sounds, this would take the prize. The whole disc is almost a solo performance by Mike Oldfield, with a little help on flute,

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).

bass and chorus. As a master work of multi-tracking it would be hard to beat but the quality suffers badly. On side one, where Mike introduces each instrument in turn, he makes the comment "Two slightly distorted guitars." This is a gross understatement. The best description would be a mixture of rock, hard and soft, pop, almost classical guitar and organ music. (N.J.M.)

★ ★ ★

HOCUS POCUS. Sandy Nelson plays the hot hits. United Artists stereo L 35029.

A grinding beat and undistinguished instrumental arrangement pretty well sum up this record. And as for the selection of tunes, I would not agree with either. The longest track is the new pop version of "Also Sprach Zarathrustra" which is enjoying something of a revival since its use in the film 2001. But even the classical version (it was composed by Strauss) is a rather monotonous tone poem at best, apart from its spectacular opening and the pop version is certainly no improvement.

The remaining ten tracks are: Hocus Pocus — Do You Wanna Dance — You Are The Sunshine Of My Life — Cherry Cherry Hallelujah Day — Cisco Kid — Pinball Wizard — Get Down — Peaceful — Roll Over Beethoven. (L.D.S.)

★ ★ ★

GREATEST LOVE THEMES (Of The Twentieth Century) Ferrante and Teicher. Stereo, United Artists (Festival) 2-record set L-45427/8 ($7.95).

Feeling jaded, tense, sour? Then four sides of these well-known, tuneful romantic melodies might just possibly dispel the mood. The popular duo-pianists are the front men but the sound is as much orchestral as anything, with a fair helping of singing strings.

There are twenty-four numbers on the four sides, a mixture of old and not so old. To quote just a few: The Very Thought Of You — Always — Love Is Blue — Didn't We — Let Me Call You Sweetheart — Laura — This Love of Mine — The Man I Love — You And The Night And Music — What The World Needs Now — O I Love You Truly.

The quality is a trifle edgy on the strings but it won't worry you unless you play it loud and attentively rather than mood style. (W.N.W.)

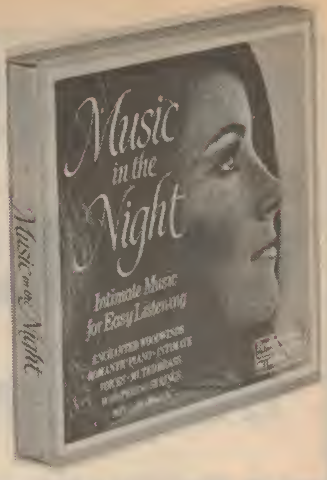
★ ★ ★

ONLY HITS. The Ventures. United Artists stereo L 25045.

The Ventures have certainly been belting out popular music for many years now and the release of this two-record set will do nothing to reduce their popularity. Most of the arrangements are good, although some people will probably brand the sound as being too "commercial." In spite of this, the album will appeal to many people who like pop music but don't like it "rock hard." Sound quality is good although tape hiss is sometimes noticeable.

Some of the twenty-four tracks are as follows: Hummingbird — Summerbreeze — Get Down — Oh Babe, What Would You Say? — Yesterday Once More — Last Tango In Paris — Duelling Banjos (from the film "Deliverance") — The Morning After — I Can See Clearly Now — The Twelfth Of Never. (L.D.S.)

Reader's Digest Album



MUSIC IN THE NIGHT. Intimate music for easy listening. Stereo, Reader's Digest / RCA 6-record packaged set.

While it's fashionable to make throw-away remarks about muted music in public places, I suspect that many people find it pleasant enough to want something like it in their homes.

Well, if you play through this "Music In The Night" set at low volume, you can have your wish. But while the producers have restrained the dynamic range with this object in view, they've left enough to make the sound enjoyable if you want to feature it a bit more.

Record 1 introduces Richard Alden, his piano and orchestra in twelve tracks which include: Two Sleepy People — I've Never Been In Love Before — My Reverie — Moonlight Cocktail — I Fall In Love Too Easily.

Muted brass takes over in record two with Peter Knight and his orchestra. Amongst their selections are: I Only Have Eyes For You — Makin' Whoopee — Mack The Knife — Let's Fall In Love — Tonight — Young At Heart.

Predictably, perhaps an electronic organ makes its appearance in record 3, but against an ample background of orchestral sound provided by the Harry Stoneham orchestra. Their selection of popular titles takes in: Moon River — The High And The Mighty — Quiet Village — Tenderly — Ebb Tide — Greensleeves — In The Blue Of Evening. Do you really need to be told that they are an organist's choice?

Then it's on to guitars on record 4 — or should I hasten to say "gentle guitars" — from the Robert Bentley orchestra. It's all very easy on the ear as they play tracks like: This Is My Song — Bluesette — Wives And Lovers — A Whiter Shade Of Pale — San Franciscan Nights — Dedicated To The One Love. As with other discs, there actually twelve tracks all told.

And what of record 5? Well that's the one for devotees of strings: not merely the singing variety but the "Whispering Strings" of Norma Percival and his orchestra. They lead off with: "Too Marvellous For Words," and "Just One More Chance," then muse about "Two Cigarettes In The Dark" (Medical authorities warn that smoking . . . etc). So the romantic mood continues till they finish with "Love Letters."

Last but not least comes record 6 with "The Enchanting Woodwinds" of Alan Copeland and his orchestra: Jungle Fantasy — September In The Rain — The Night Has A Thousand Eyes — The Tavern — Too Little Time, etc.

Each group is complete on the one disc so that, if you stack and play in changer mode, you'll get six sides in sequence, followed by the other sides in reverse sequence.

The surfaces are quiet and the sound clean on these RCA dynagroove pressings. No worry on that score. The one reservation I had was that a couple of the typically thin RCA pressings were somewhat warped as they came out of the pack and the rolled outer edge came within a whisker of fouling the heel of the cartridge. But, if you've had no worry with this style of disc in the past, these should be okay.

So there you have it: no less than 72 tracks of pleasant, restful music. (W.N.W.)

VARIETY FARE

TOUCH ME IN THE MORNING. Johnny Pearson and his orchestra. Penny Farthing stereo L 35034. Distributed in Australia by Festival Records Pty Ltd.

Piano and orchestra with sweet and sometimes uptempo arrangements sums up this album. Johnny Pearson does a very pleasant version of "Tie A Yellow Ribbon Round The Old Oak Tree" and "Sing" but he should have given "Also Sprach Zarathrustra" a miss. Record quality is good.

Remaining tracks are as follows: Touch Me In The Morning — Tell Her You're A Lady — Brother Sun And Sister Moon — Live And Let Die — Killing Me Softly With His Song — Autumn Reverie — If — St Louis Blues. (L.D.S.)

★ ★ ★

WAVE. Rosemary Bailey. Interfusion stereo L 25045.

According to the album notes, Rosemary Bailey was a child prodigy. Started on the piano at five, moved to organ at nine, she became a freelance demonstrator for the Hammond Organ Company at thirteen. At nineteen she joined the company as a full-time concert artist. This LP was recorded on a recent trip to South Africa.

I don't know how old Rosemary is now but she is still very competent on the organ. Surprisingly, there is no mention or description of the organ she is playing. My one comment is that the album would be more enjoyable if she made less use of the synthetic rhythm accompaniment. Anyone know a drummer who wants to get married?

Fifteen tracks are featured: Do You Know The Way To San Jose? — Put Your Hand In The Hand — Bluesette — Fly Me To The Moon — One Note Samba — Night And Day — Wave — Hey Jude — Girl Talk — With A Little Help From My Friends — Up, Up And Away — Something — Quando, Quando, Quando — Close To You — Desafinado. (L.D.S.)

★ ★ ★

WOODY HERMAN. GIANT STEPS. Fantasy Records L35086. Festival Release.

Woody Herman has long been an innovative force on the Jazz scene and this record shows he has lost none of his skill with the passing years. A big line up of jazz talent, both in solo performances and as a group gives the listener plenty of enjoy on the nine tracks; La Fiesta — A Song for You — Freedom Jazz Dance — The Meaning of the Blues — The First Thing I Do — Think on Me — Giant Steps — A Child is Born — Be-Bop and Roses. The quality is excellent. A few of the musicians listed are: Bill Stapleton, Geoff Sharp, Harold Garrett, Frank Tiberi, Andy Laverne, Wayne Darling. (N.J.M.)

★ ★ ★

RUSS CONWAY, With Songs From Stage and Screen. Astor Golden Hour Series GH561 Stereo.

I found great pleasure in reviewing this record, with twenty all-time favourites on piano, with an excellent rhythm backing. For your money you get: Cabaret — Raindrops Keep Falling On My Head — I Want To Be Happy — The Shadow Of Your Smile — Days Of Wine And Rose — Hello Dolly — I Will Wait For You — Charade — A Man And

A Woman — Moon River — Peyton Place, and nine others. An ideal background for dining or that not so noisy party. Quality is excellent. (N.J.M.)

★ ★ ★

PARTY SING SONG. Frankie Vaughan, with orchestra. Stereo, Columbia SOEX 10119.

Enthusiastic vocals by Frankie Vaughan, big band accompaniments, and 24 well known songs of the type indicated by the disc title — all this sounds pretty good value for $2.99, the price of this disc. As a sing along type of entertainment, the titles should carry their own recommendation, including as they do such firm favourites as Baby Face — All Of Me — You Made Me Love You — Swanee — When The Red Red Robin — Blue Skies — Sweet Georgia Brown . . . and so on. The sound quality is not particularly good and, although the sleeve carries the annotation "Produced in 1973" I doubt whether the recording is a recent as this. However, for a party disc, it is acceptable. (H.A.T.)

★ ★ ★

PARTY SINGALONG WITH MAX BYGRAVES. Columbia Stereo SOEX 10080.

There is quite a lot of charm in these songs presented by the old favourite, Max Bygraves. Why not introduce your children to some of the old songs? Sound quality is dated, even though it has been reprocessed electronically for stereo. Price is just $2.99.

Songs featured are: Meet Me On The Corner — Gilly Gilly Ossenfeffer Katzenellenbogen By The Sea — Mister Sandman — Big Head — She's A Lassie From Lancashire — When Irish Eyes Are Smiling — I Belong To Glasgow — Any Old Iron — Heart Of My Heart — The Dummy Song — Try Another Cherry Tree — Out Of Town — When You Wore A Tulip And I Wore A Rose — If You Were The Only Girl In The World — For Me And My Gal. (L.D.S.)

★ ★ ★

THE GOLDEN SONG BOOK, Vikki Carr. United Artists L4591 / 2 Festival release. Two record set $7.95.

Vikki Carr has long been a favourite of mine and this special price album should please her fans, with twenty old and new hits, including: Alfie — By The Time I Get To Phoenix — It's Not Unusual — Bye Bye Blackbird — Baby Face — I've Grown Accustomed To His Face — Anyone Who Had A Heart — Strangers In The Night — Time After Time — The Surrey With The Fringe On Top — My Prayer. The backing orchestra is not named but does a first class job and the quality leaves nothing to be desired. In all a very enjoyable album for those who like the artist. (N.J.M.)

★ ★ ★

MY FAVOURITES OF HANK WILLIAMS, GEORGE JONES. United Artists L35025. Festival release.

Country and Western fans have been well looked after lately, judging by the number of records coming up for review, and this release from United Artists offers a dozen favourites from the pen of Hank Williams.

Included are: You Win Again — Mansion On The Hill — Lonesome Whistle — Your Cheating Heart — I Heard You Crying In Your Sleep — Take These Chains From My Heart. The vocal is a trifle too nasal in tone for my taste but the quality is good. (N.J.M.)

WALES LAND OF SONG. Golden Hour Stereo GH520 Astor release.

If you enjoy the thrilling sound of a Welsh male voice choir, you will have to overlook the somewhat disappointing quality on most of the eighteen tracks on this record. I get the feeling it was recorded in Winter time and somebody put a sock over the microphone to keep it warm; the upper register suffered accordingly!

Some of the best known tracks are: Land of my Fathers — Salute to Wales — Going Home — David Of The White Rock — Men Of Harlech — All Through The Night — Bless This House — Ash Grove — The Rising Of The Lark. The artists are, Ivor Emmanuel, the Rhos Male Voice Choir and the Band and Choir of the Welsh Guards. (N.J.M.)

★ ★ ★

THE SHADOW OF YOUR SMILE. Edward Woodward. Two record set L45373 / 4 Festival release.

If you're used to seeing Edward Woodward as the rather unpleasant "Callan" on TV, you are in for a pleasant surprise when listening to this $7.95 two record set of popular ballads. Twenty three in all, they include: I'll Never Fall In Love Again — September Song — Morning Has Broken — The Windmills Of Your Mind — People — The Way You Look Tonight — Scarborough Fair — Eleanor Rigby — Moon River — The Shadow Of Your Smile — All The Things You Are.

His voice and presentation would put to shame many a better known singer; let's hear more like this. The quality, by the way is marred on my review copy by a slight harshness on some tracks. (N.J.M.)

VARIETY FARE

JILL PERRYMAN. I Feel A Song Coming On. EMI EMC 2511.

Jill Perryman really lays 'em in the aisles with this full throttle performance of a dozen big show hits of the musical stage. If you like Gershwin, Rodgers & Hart, Youmans, to name a few, don't pass this record by. I feel our local superstar can outsing a lot of overseas talent. The tracks, backed by the Richard Bowden Orchestra are: I Feel A Song Coming On — Singing In The Rain — Someone to Watch Over Me — Manhattan — Mad About The Boy — Johnny One-Note — People — Tea For Two — They Can't Take That Away From Me — Stormy Weather — The Continental — The Lady Is A Tramp.

The quality is superb; don't miss it. (N.J.M.)

★ ★ ★

AN AMERICAN ALBUM. Nana Mouskouri. Fontana stereo 6325 319.

Released to coincide with the visit to Australia of Nana Mouskouri, the sales of this album are virtually assured. Australians are already well familiar with this personable singer of Greek birth. Over the past few years Nana has developed more intensity in her singing which certainly adds to her appeal. Sound quality is okay.

Eleven tracks are featured: To Be The One You Love — Mayday — I Dream You — Danny Come Home — Where Did They Go — Dance Over The Water — The Singer — The Loving Song — Dandelion — Like A Main Theme — Just Another Face. (L.D.S.)

★ ★ ★

THE ANDREWS SISTERS. Astor / MCA 2-record set MAPS-7058 ($7.95).

Remember the Andrews Sisters? If you can remember the 30's and 40's, the answer to that question can scarcely be anything but a "yes." How could one possibly forget the team that turned out fifty million records and seventeen movies?

If you want to be reminded afresh of Laverne, Maxine and Patti, Astor give you plenty of opportunity with this 2-record set and 24 numbers including: Beer Barrel Polka — Sonny Boy — Don't Sit Under The Apple Tree — Bei Mir Bist Du Schon — Apple Blossom Time — Say Si Si — Tico Tico — There Will Never Be Another You — Oh Johnny . . . and so on.

While the album is branded "stereo," the recordings hardly belong to the stereo era. But, in common with many which have been re-mastered, you'll hear them to better advantage now than ever you would have on the old 78rpm shellacs. There's certainly none of the old grinding and scratching to spoil your nostalgic trip. (W.N.W.)

★ ★ ★

THIS IS PAT ROBERTS. DOT RECORDS L35013 Festival release.

Pat Roberts is a fast rising talent on the American country music scene. His voice is easy to listen to and shows a lot of confidence in the eleven tracks on this record, including: Here Comes My Little Baby — Thanks For Loving Me — You Lay So Easy On My Mind — I'm Gonna Keep Searching — Rhythm Of The Rain — Funny Face — A Whole Lotta Lovin. The instrumental backing is good in its own right and serves to enhance a very pleasant record. (N.J.M.)

★ ★ ★

THE IRISH ROVERS. EMIGRATE, EMIGRATE. Potato Records L35052 Festival release.

The unmistakable style of the Irish Rovers comes through on this mixture of humour, sadness and bitter comment. Most of the tracks deal with the early migrants to North America but "Children of Hate" and "Catch Another Butterfly" carry very up to date themes, one with the present troubles in Ireland and the other with ecological problems. The other titles are: The Passing of the Gale — Yellow Gals — Paddy's Green Shamrock Shore — Farewell to Carlingford — Mary of Dungloe — Emigration Medley — Cobblers — Paddy on the Railway — Canadian Railroad Trilogy — Northern Rake — The Gypsy.

In all, a very enjoyable record, with food for thought. (N.J.M.)

The Green, Green Grass

GREEN, GREEN GRASS OF HOME. Various artists. Stereo, Reader's Digest boxed set of six records. Available only from Reader's Digest Association Pty Ltd.

This set has all the well known features of the Reader's Digest "packaged deal" — six discs splendidly packaged and well recorded in the RCA Dynagroove system. Certainly these features leave no room for complaint.

Where some people may be disappointed is in the rendering of the melodies (which number no less than 72). If you are an admirer of the modern folk song troubador you may find these renderings too bland and lacking in character. Any suspicion of protest has been removed from songs with an anti-war or social message, either by way of rewritten lyrics, or by presenting them in instrumental form only.

If the foregoing sounds rather less than enthusiastic, let me hasten to add that for the purpose for which this music is undoubtedly intended — family entertainment — the set would give a great deal of pleasure and satisfaction. The sung arrangements are smoothly presented by accomplished, if by relatively unknown performers; the only real big name included is Chet Atkins, but his relaxed style of guitar playing is featured in only one track.

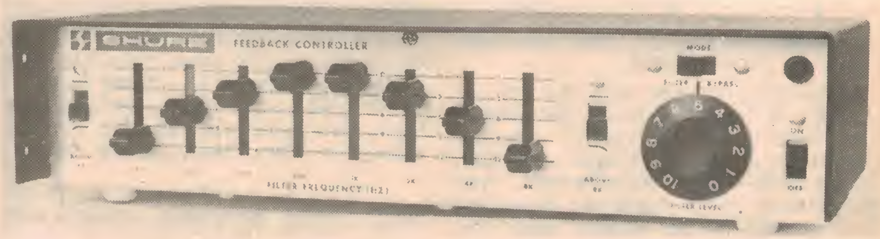
It would be impracticable to list all the titles, but the following selection should give a fair idea of the contents as a whole.

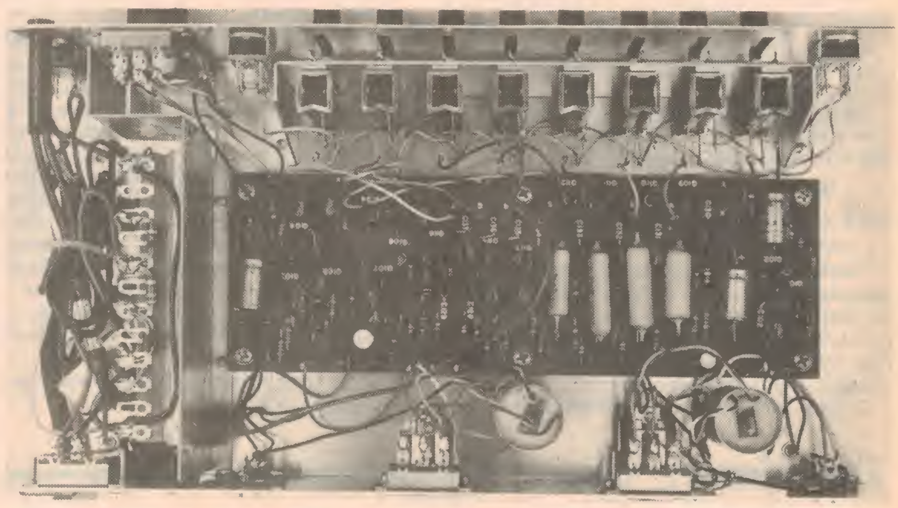
Tom Dooley — Gentle On My Mind — The Times They Are A-Changing — I Am A Rock — Mrs Robinson — MacArthur Park — King Of The Road — 500 Miles — This Land Is Your Land — Wichita Linesman — Ode To Billy Joe — Galveston — Where Have All The Flowers Gone — The Sound Of Silence — Scarborough Fair — Blowin' In the Wind — Little Green Apples — Honey — Leaving On A Jet Plane. For the kids, there is a whole side devoted to such juvenilia as Puff The Magic Dragon — The Unicorn — Circle Game, etc. (H.A.T.).

Product reviews & releases

Shure M610-2E Feedback Controller

Anyone experienced in public address work will know of the problems which can occur with acoustic feedback. Shure Brothers Inc have brought out the M610-2E Feedback Controller to aid in curing these problems.





Much can be done with public address systems suffering from acoustic feedback. Microphone and loudspeaker placement can be optimised and the microphone characteristics can be specially selected to suit the application. But even after these approaches have been applied, acoustic feedback can still be serious, particularly at "pop" concerts where very high power levels are employed.

Looking at the problem in another way, acoustic feedback in a public address system is the limiting factor on how much gain can be applied — turn up the gain past a certain point and the whole system breaks into a howl. In many situations where acoustic feedback does occur, the gain that can be achieved before feedback is nowhere near adequate. So any means of improving the situation can be a real blessing; enter the Shure M610 feedback controller.

Anyone who has heard acoustic feedback (and who hasn't?) has probably realised that the "howl" or high-pitched "squeal" is centred on only one or two frequencies. If the gain can be reduced at these frequencies, the howl will stop. And that is essentially what is done with the Shure Feedback Controller. It has eight dip filters with variable attenuation to a maximum of 12dB. The dip filters are centred with approximately octave spacing at 63, 125, 250, 500, 1k, 2k, 4k and 8kHz.

The filters work in much the same way as those in an Active Equaliser in a hifi system, to smooth out major irregularities in the overall system response. The difference is that the filters in the Shure Feedback Controller act only to reduce gain rather than to boost or cut as in an active equaliser.

Besides the eight dip filters, there are two slide switches to insert a 6dB rolloff above and below those frequencies covered by the filters. So the feedback controller can selectively control the whole audio spectrum.

In use, the Feedback Controller is interposed in the signal line between microphone and public address amplifier and the system set up for normal operation. The gain of the system is advanced until acoustic feedback sets in. At this point the appropriate filter control corresponding with the frequency of the howl is depressed until the acoustic feedback ceases. Then the gain control can be further increased until feedback again sets in and filters readjusted. This process of adjustment, which may take several steps and perhaps some adjustment to all the filter controls, continues until a satisfactory level of gain is obtained without feedback.

Inputs are provided for microphone or auxiliary source. The microphone input is designed for low impedance (unbalanced or balanced) mics from 25 ohms to 600 ohms or high impedance (33k, unbalanced) dymamic, ribbon or condenser microphones. Crystal or ceramic microphones are not recommended. The mic impedance is selected by a slide switch immediately above the mix socket, which is a professional type to take Cannon XL or Switchcraft A3 series connectors.

Use of the Auxiliary input automatically switches the microphone socket out of circuit. The Auxiliary input accepts signals from high level sources such as a tape recorder or tuner. A similar RCA phono socket is provided for a high level output.

Power requirements are flexible. It can be run from the 240V mains or from 30V DC at a current drain of 12 milliamps.

Inside, the unit is simple but well made. The microphone transformers (for input and output) are potted to prevent the entry of moisture. The circuitry does not use inductors for the filter functions, is all accommodated on a single board and the power supply is shielded from the rest of the circuitry to prevent hum induction. Sixteen transistors and two diodes make up the semiconductor complement.

All told, we found the unit lived up to its specifications. Filter frequencies were within 10pc of the nominated figure and the maximum attenuation of any filter was 12dB as specified. Interaction of the controls was at a minimum. Our only complaint is that the horizontal calibrations for the sliders which supposedly give the degree of attenuation in decibels, were not accurate. Moving a slider to say 3 or 6 gives something less than that number of decibels attenuation at the nominated frequency.

Still, considering how the unit will generally be used, the accuracy of these calibrations is probably not very important.

Distortion was less than the rated level of 0.5pc at all times, over the whole of the audible frequency range — which is good for this type of circuitry. Noise was similarly low. Auxiliary output hum and noise level for a bandwidth of 20Hz to 20kHz was minus 70dB with respect to a level of 1 volt.

In short, the Shure Feedback Controller is a well-made unit which will find application in many PA and concert situations. In fact, it could probably be used to advantage in every PA system currently in use. Certainly there are very few systems in existence which are totally free of feedback or ringing at the levels at which they are used.

Recommended retail price of the Shure M610-2E Feedback Controller is $225 including sales tax. Further information may be obtained from the Australian distributors for Shure products, Audio Engineers Pty Ltd, 342 Kent Street, Sydney, NSW. (L.D.S.)

Kikusui 418 Audio Oscillator

There are now quite a few audio oscillators for the technician to choose from, but there are relatively few that offer low distortion and reasonable price. The Kikusui 418 is a well-made unit with both low distortion and a reasonable price.

The styling of the Kikusui model 418 is reminiscent of several much higher priced instruments. It has an 80mm diameter dial clearly calibrated from one to ten and a bank of five push-buttons to select the frequency range. Another bank of four push-buttons selects sine or square wave out, 0dB or minus 20dB output level and switches on the power.

A small knob varies the output level and a light emitting diode is used as the pilot lamp. Output signal connection is via binding post terminals 19mm apart. The black GND terminal is connected to the instrument chassis and hence to the mains earth.

Dimensions are compact at 110 x 140 x 252mm (W x H x D) and the weight is light at approximately 2kg.

Frequency coverage is from 10Hz to 1MHz and the frequency accuracy of the dial is plus or minus 3pc plus 1Hz. Output impedance is 600 ohms. Output voltage for sine waves is 4V RMS (with 600 ohm load) and for square waves is 8V p-p or more into 600 ohm load.

Harmonic distortion is fully specified: from 10 to 20Hz, less that 1.5pc; from 20 to 100Hz, 1pc or less; 100Hz to 1KHz, 0.5pc or less; 1kHz to 100kHz, 0.3pc or less and 100kHz to 1MHz, 1pc or less. Rise time of the square wave output is 0.2 microseconds or less while overshoot is less than 2pc and sag is less than 5pc (at 50Hz). Operating temperature range is zero to 40 degrees Celsius.

A bonus with the unit is the very well written manual, which would be particularly handy for technical college use.

Removing three screws at the rear of the case lets the chassis slide out for easy access to all components. Circuitry is accommodated on two PC boards, one large, one small. The push button switches (Isostat type) are soldered directly into the boards so there is very little wiring inside the open chassis.

The circuit is a well-refined Wein bridge configuration with a FET front end allowing a tuning capacitor to be used. The tuning capacitor allows good tracking between its ganged sections and consequently the envelope stability when sweeping over the dial is good. Incidentally, the large clear circuit diagram should help minimise servicing problems, although the local distributors have full servicing facilities anyway.

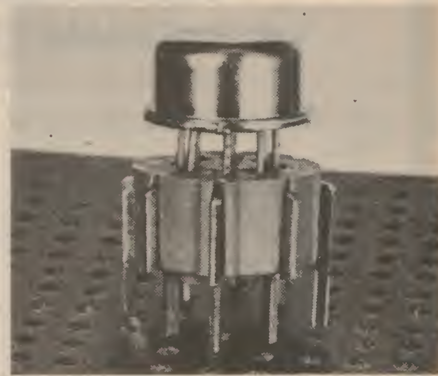
Square wave output is provided by a Schmitt trigger circuit adjusted for 50pc duty cycle. Signal from the attenuator is fed to an emitter-follower circuit with a constant current load and thence via two 1.2k resistors in parallel to the output terminals. All in all, the circuitry is well thought out and should provide reliable service.

Performance specifications were easily met by the sample unit tested. Distortion at around 100Hz was typically 0.2pc while at 1kHz and higher up the range it was around 0.2pc.

At the price of $88 plus sales tax where applicable, the Kikusui model 418 audio oscillator should prove very attractive to

hobbyists, technicians and technical institutions alike. It is distributed in Australia by Jacoby, Mitchell & Co Pty Ltd, 215 North Rocks Rd, North Rocks, NSW. (L.D.S.)

New IC socket from McMurdo



A socket for an eight-lead TO5 IC package which fits directly into a 0.1 inch pitch printed wiring board has been added to the Jermyn range of products from McMurdo (Australia) Pty Ltd. The socket accepts the device without bending the leads.

Because the socket pins are on the outside of the socket body, testing from above the board can be carried out. This arrangement also provides more space between the pins for soldering. The gold plated bronze contacts are rated at 1 amp, and the "lead-ins" are funnel shaped to make insertion of the device easier. Insulation resistance between pins is in excess of ten to the tenth ohms at 500V DC, and the socket body is mouled from glass-filled nylon.

Further information is available from McMurdo (Australia) Pty Ltd, 19 Carinish Road, Clayton 3168.

IC audio amplifiers from Plessey

Plessey Ducon Pty Ltd now have available the SL414A and SL415A integrated circuit audio power amplifiers, which supersede the SL403A and SL403D series. The new amplifiers are electrically identical to the superseded units but have improved heatsink connections.

For some time now, the Plessey SL403 series integrated circuit amplifiers have been unavailable. Plessey Ducon Pty Ltd now have ample stocks of the SL414A 3 watt and the new SL415A 5 watt unit. These use the same 10 pin package as the old units and consequently can be substituted in any circuit designed around the SL403 series.

Power delivered by the SL414A is 3 watts (typical) into a 7.5 ohm load with a 24V supply.

An improved heatsink mounting arrangement is a feature of the new integrated circuits. Instead of the two large tabs of the SL403 series, the new unit has a large stud in the centre of the package. The stud is threaded to take a finned heatsink such as the Redpoint type TV-16 or it can be connected to any suitable heatsink with an area of at least 20 sq cm.

Trade enquiries should be directed to the Professional Products Division of Plessey Ducon Pty Ltd, PO Box 2, Villawood, NSW 2163.

Revolutionary new slide projector

A revolutionary new slide projector, featuring advanced projection techniques, is to be marketed in Australia later this year by Hanimex. A prime feature of the new unit is its high speed projection capability.

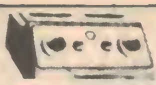
The new projector, known as the Rondette 110, employs no magazines, cubes or slide containers of any type. Instead, it uses an endless nylon belt just over an inch wide, on the outside of which slides are mounted in spring steel clips. Belts can be purchased in either 40, 80, or 120 slide sizes, and a fully loaded 120 slide carrier stores in no more space than a standard 36 slide tray.

The Rondette 110 is capable of projecting a full belt of 120 slides in just over half a minute — approximately four times faster than conventional machines. At such speeds, sequential slides of any type come very close to projecting movement. For instance, a series of rapid action shots of a diver projected at full speed will give a startlingly lifelike appearance of motion. Actually the maximum projection speed is about 3.5 frames per second, as compared to the usual movie slow motion speed of six frames per second.

Slides are slipped into the clips in no more time than it takes to load an ordinary tray, and since the slides do not form a link in the changing process, it is practically impossible for the machine to jam. The carrier drops over a pair of spindles, one of which is spring-loaded to keep the carrier at the proper tension as it travels. As each slide moves into projection position it is held in exact 90 deg alignment while the preceding and the following slides are held out of the path of the light. A the same time, a curved shutter on a curved track moves in exact synchronisation with the slide, with no light spillage or "blooming."

The Rondette 110 incorporates a number of other advances, including a control console that doubles as a remote control handset. The machine can either be operated conventionally or, by pulling out the console, from a remote position. Also included is an improved forced draft suction cooling system that, by cooling the slide, ends the possibility of buckling. There is an input for sound synchronisation, a built-in carrying handle, and a built-in lens protection hood. The body is formed of a tough polycarbonate built to withstand abuse.

The Rondette 110 expected to be on sale in Australia later this year. For further information contact Hanimex Pty Ltd, Old Pittwater Road, Brookvale, 2100, NSW. Telephone 93 0122.



NEW ALL SILICON 30/60W PA PORTABLE AMPLIFIER

12-16V, two inputs, 5mV and 100mV. Dimensions 6½in W x 3¼in H x 8½in D. 15-ohm output, No 763D, **$67** For 125, 250, 500-ohm output, No 763A, **$69**. For 240V operation $33 extra.

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LOW IMP input, 2 trans, 672C	$7.00
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Wired ready for use, 682D	$10.00

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70A1	850 ET 034A	872 73 BA9
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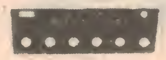
70P1	853 72 EA M12	874 ET 520
70G7	858 EA 73 3c	875 73 P11
	859 ET 518	876 73 TU11
	860 EA 73 01	877 ET 1801a
795 ET 025	861 ET 416	878 ET 160e
830 72 R2	863 ET 521	879 ET 601l
832 71A8	864 73 S6	880 ET 601n
834 ET 026	865 73 TU7	881 ET 6J1b
835 72 T3	866 ET 414D	882 ET 524



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10 + 10W RMS

With output transistor PROTECTION. Frequency response 40Hz to 30kHz. Distortion 0.5 per cent. Treble, bass boost, 20dB.

Wired and tested. No 480D	**$81.00**
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No 30 pulse filter, 2A	$12

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In 80mV, out 250mV. Bass and treble 20db.
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400Hz,	0dB	Connect between your
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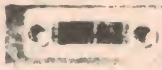

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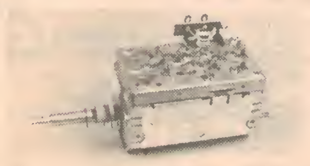

Stereo amplifier and tuner solid state 10 watts per channel RMS new well known make **$50**.

Speaker transformers 7000 to 15 Ohm 3½ watt **$1.25**.

100 mixed condensors micas polyester ceramic fresh stock **$2** per 100 pack and post 25c.

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BSR latest 202 top model of BSR range of record players **$52** including Magnetic Cartridge. Pack and post $1, interstate $2.

50 / Ohm pots ideal for ext. speakers etc **50c**.

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Morganite and IRC resistors 33 values **$2** per 100 pack and post 25c.

Portable 4 speed record player 240 volts all transistor **$19.50**. Pack and post $1, interstate $1.50.

SUIT HOMODYNE TUNER
Car Radio Push Button Tuner
$4.50
Pack & Post 55c. Interstate 85c.

NEW PRODUCTS

Arlunya PG-100E test pattern generator

Arlunya Pty Ltd has released an extremely versatile test pattern generator for carrying out rapid fault diagnosis and alignment of colour TV receivers. Designated the PG-100E, the new unit features an electronically generated circle and spot which can be superimposed on all the basic patterns.

Fully designed and manufactured in Australia to meet the relevant CCIR standards and the specifications laid down by the Australian Broadcasting Control Board, the Arlunya PG-100E is intended for use in factory production alignment and testing, service workshops, customer house call servicing, and teaching applications.

In addition to the thirteen basic patterns (ie colour bars, red, green, blue, white, delay, chequerboard, circle, spot, crosshatch, dots, vertical bars, and staircase), the PG100E features continuous control of burst amplitude, as well as the facility to select between PAL and NTSC encoding of the colour sub-carrier. Where desired, the U and V components of the chrominance signal can be switched off independently.

The unit also features swinging burst / non-swinging burst operation for testing colour killer circuits, and modulated / unmodulated sound carrier operation for audio circuit testing. In particular, the electronically generated circle and spot are useful for performing receiver linearity adjustments and checking EHT regulation on screen respectively. Both video and RF output are available, with line and sync frame outputs for triggering an oscilloscope.

Price of the PG-100E is $475 (excluding sales tax). For further information contact Arlunya Pty Ltd, PO Box 113, Balwyn, Victoria 3103.

The Arlunya PG-100D. This unit has b .en superceded by the PG-100E, which features an electronically generated circle and spot.

Digital logic trainer from Hewlett Packard

Pictured at right is Hewlett-Packard's recently released Model 5035T Logic Lab. Designed specifically for training applications, the unit comes complete with a large package of standard logic components, interconnecting wires, four LED numeric displays, and two textbooks. A short-circuit proof 1A power supply is built into the unit, together with a 1Hz-100kHz pulse source.

Included with the Lab are three professional-quality troubleshooting instruments: the HP 10525T Logic Probe, the 10526T Logic Pulser, and the 10528A Logic Clip.

For further information contact Hewlett-Packard Australia Pty Ltd, 31-51 Joseph St, Blackburn, Victoria 3130.

Books & Literature

Basic electricity

ENGINEERING PRINCIPLES FOR PART 1 ELECTRICAL AND TELECOMMUNICATION TECHNICIANS, by J. O. Paddock and R. A. W. Galvin. Published by the English Universities Press Ltd, London, 1973. Soft covers, 138 x 217mm, 354pp, many circuits and diagrams. Suggested Aust retail price $5.70 soft cover, $8.95 hard covers.

This book is part of the EUP "General Technical" series, written as course texts for the City and Guilds of London technician and technician engineer courses. The present book is designed to cover the syllabus of a first year "Electrical Principles" course, together with that of a second year "Electrical Engineering Principles" course. As such it may therefore be suitable for use as a text for the early levels of any similar technician courses.

The book is divided into seventeen chapters, whose titles give a fair idea of the material covered: 1 — Electric Circuits 1; 2 — Electric Circuits 2; 3 — Electro-chemical Effects; 4 — Mechanics 1; 5 — Mechanics 2; 6 — Mechanics 3; 7 — Temperature and Heat; 8 — Heating Effects; 9 — Magnetic Fields; 10 — Magnetic Circuits; 11 — Electric Fields; 12 — Alternating Currents 1; 13 — Alternating Currents 2; 14 — Electrical Machines; 15 — Electronics 1; 16 — Electronics 2; 17 — Electrical Measurements. Each chapter ends with tutorial questions, the answers to which are given at the end of the book.

The text is concise and clearly presented, and is well served by illustrations. There are many worked numerical examples, and this together with the tutorial problems would make the book very suitable for private study as well as its stated application.

The review copy came from the publisher, who advises that it is being distributed in Australia by Hodder and Stoughton (Aust) Pty Ltd. (J.R.)

Computer texts

PROGRAM DEBUGGING, by A. R. Brown and W. A. Sampson. Published by Macdonald & Co Ltd, London, 1973. Hard covers, 145 x 223mm, 166pp, diagrams. Suggested Aust. retail price $9.35.

USE OF FILES, by D. R. Judd. Published by Macdonald & Co Ltd, London, 1973. Hard covers, 145 x 223mm, 146pp, diagrams. Suggested Aust. retail price $7.45.

PROGRAMS FROM DECISION TABLES, by E. Humby. Published by Macdonald & Co. Ltd, London, 1973. Hard covers, 145 x 223mm, 91pp, diagrams. Suggested Aust. retail price $7.45.

Three more volumes in the Macdonald "Computer Monographs" series, which as these titles suggest is mainly intended for programmers and systems analysts. As yet there would appear to be few titles in the series intended for the engineer or technician, although the technical reader interested in programming may find some of them of interest. Others, like the present volumes, are perhaps rather too deep and erudite to be of value to any except the professional — and I suspect that not too many working programmers or analysts will find them easy reading!

For the really serious computer student, then.

The review copies came from Novalit Pty Ltd, of Royal Place, off 210 Swan Street, Richmond, Victoria. (J.R.)

Substitution guides

TRANSISTOR EQUIVALENTS AND SUBSTITUTES, by B. B. Babani. Second book, 1974, published by Babani Press, London. Soft covers, 110 x 180mm, 220pp. Price in U.K. 95 pence.

HANDBOOK OF INTEGRATED CIRCUITS (ICs) EQUIVALENTS AND SUBSTITUTES, by B. B. Babani. First edition, 1974. Published by Bernards (Publishers) Ltd, London. Soft covers, 110 x 180mm, 122pp. Price in U.K. 75 pence.

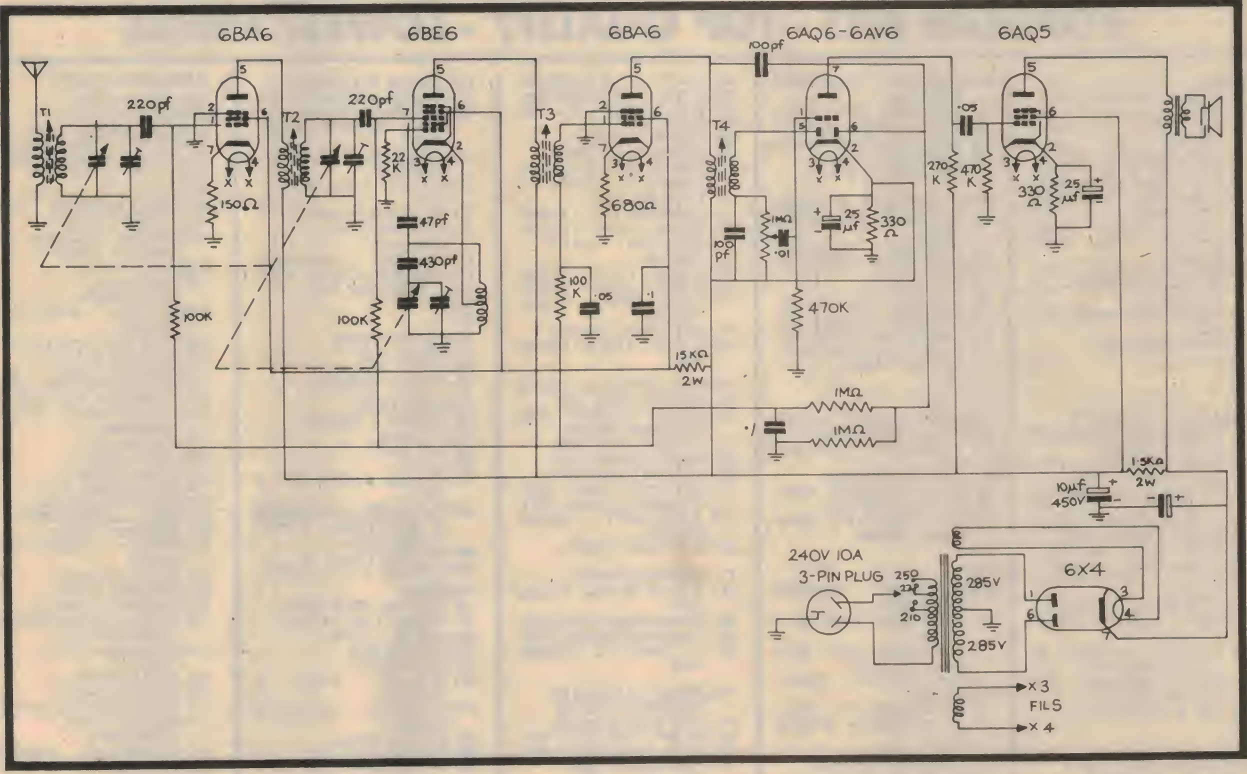
Two very useful little handbooks dealing with the substitution of semiconductor devices, and intended for the service technician, the experimenter and the radio amateur. One only has to flip through them to have a dramatic demonstration of the size of the substitution problem which these and similar books try to solve.

Author Babani should be well known to many readers, having written many technical books. In his introductions to the present volumes he notes that the devices covered include those of European, American, Japanese, Czech and Polish manufacture. They should thus be of considerable value, and well worth their modest cost, particularly to the service technician. (J.R.)

TRANSISTOR EQUIVALENTS, 8th edition, revised by A. M. Hoebeek. Published by De Muiderkring, B. V., Bussum, Holland. Soft covers, 127 x 174mm, 256pp, Price in Australia $4.95 plus 65 cents postage.

Another handbook of transistor equivalents, from the Dutch De Muiderkring publishing house. It has much the same information as the first of the two Babani books listed above, and the two correlate fairly well. It is printed on somewhat better paper, and is organised in a little more systematic way, but on the other hand is likely to cost you a little more. The choice between the two will largely be a matter of personal taste. (J.R.)

One year from now you'll be able to read this circuit as easily as the back of a cornflakes packet.



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The Amateur Bands

by Pierce Healy, VK2APQ

Radio communication — early experiments

The centenary of Guglielmo Marconi's birth recalls many epics associated with early radio experiments. Its introduction into ships helped assess its potential value.

From 22nd April, 1974, to 7th June, 1974, the World Administrative Maritime Radio Conference of the International Telecommunication Union, was held at Geneva, Switzerland. In attendance were 470 delegates representing 90 member nations. Also present were observers representing the International Amateur Radio Union.

On 25th April, the hundredth anniversary of the birth of Guglielmo Marconi, the United Kingdom delegation to the conference presented a bust of the famous scientist to the Secretary-General of the ITU on behalf of the Marconi Companies.

Throughout the world, amateurs have in some way paid their respects to the memory of Marconi. In Australia, the South Australian division of the WIA produced a special QSL card to mark the occasion. These were available to all Australian amateurs.

Another event associated with the ITU conference was the "6th World Telecommunication Day" on May 17th.

To mark that event the ITU issued a news release giving some interesting facts about early radio experiments associated with shipping, aviation and other forms of transport.

There is no doubt that many ships' operators in those days were also amateurs and the events recorded may have to some extent included a measure of amateur ingenuity, although not recorded as such in official records. However, the facts given are most interesting.

After commenting on the fact that radio signals know no man-made frontiers, reference is made to experiments of several of the pioneers of communication by radio. The formation and growth of the Marconi company is mentioned along with incidents involving ships at sea and the necessity for international regulations and procedures to be adopted.

Space does not permit repeating the release in full but the main points are given.

In March, 1897, Alexandra Popov, the Russian physicist, established a radio station near St. Petersburg and equipped the cruiser "Africa" with his apparatus. In 1899 communication was established between the battleship "Admiral Aprasin" and the coast, a distance of 72km.

Commercial operation began with the formation of Marconi's Wireless Telegraph and Signal Company Limited on the 20th July, 1897.

Keen competition existed in the manufacture of equipment. In Germany Adolph Slaby, who invented resonant coils to measure wavelength, joined with Count George von Arco and the A.E.G. in the manufacture of wireless equipment. Their company, Braun, and Siemens and Halske were amalgamated in 1903 as Telefunken. To keep his lead, Marconi, instead of only manufacturing equipment decided to organise a great wireless system of his own.

To carry out this plan, the Marconi International Marine Communications Company was created in 1900, and from May 1901 Marconi stations were opened in Britain, Ireland, Italy, Canada, Belgium and Newfoundland. Marconi operators were placed on ships fitted with his equipment. They were forbidden to communicate with any other station or ship unless it was a Marconi station.

John Ambrose Flemming was scientific adviser to the Marconi company and the Edison Electric Light Company in London, and on 16th November, 1904, applied for a patent for a thermionic valve.

In 1906, Lee de Forest, an American radio engineer, quite independently of Flemming, developed the triode or audion valve. It is said that his "glass bottle full of nothing" probably contributed more to the rapid development of radio and electronics than anything else. Besides being useful for audio amplification, Alexander Meissner, in 1913 found that when combined with an oscillatory circuit it generated electromagnetic waves. By 1914 it began to replace the arc as a producer of continuous radio waves.

Three dramatic events at sea showed the whole world the real value of radio communication.

At 5.30 am on 23rd January, 1909, the 15000 ton ship Republic, in deep fog about 280km off the United States east coast, struck the west bound Italian steamer Florida with 800 emigrants aboard.

The Republic's radio officer, Jack Binns, transmitted the distress signal — CQD — to Siasconset on the American coast and from there it was relayed to other ships in the neighbourhood. The first to arrive was the Baltic which received the request 30 minutes after it had been sent out and was brought alongside entirely by messages from the Republic.

All 1700 souls from the two ships were saved. This was the first time the whole world had known of a major accident at sea, and been able to follow rescue operations. Without wireless, no help could have been summoned, nor would anyone have known about the disaster.

In July, 1910, quite a different service was rendered. A notorious British murderer, Dr Crippen, had escaped with his secretary and was fleeing aboard the Canadian Pacific liner Montrose from Antwerp.

The captain's suspicions were aroused by a strange passenger and his "son". He contacted his company's offices by wireless and obtained a detailed description of Crippin and his companion, who had disguised herself as a boy. Their presence aboard was radioed back and Chief Inspector Drew, from Scotland Yard, set out for Canada aboard a faster vessel, the Laurentic. So began a race across the Atlantic, known to the whole world, but unbeknown to the fugitives. Both were arrested on arrival in Canada.

The most dramatic event of the early history of radio at sea was the loss of the Titanic with 1503 souls. Striking an iceberg on 14th April, 1912, when attempting to beat the record for an Atlantic crossing during her maiden voyage, the Titanic's distress signals were heard by the Carpathia, which was able to rescue 710 survivors.

As more ships were fitted with radio trouble began. Because spark transmitters occupied a lot of space, two chatting operators blanketed most other vessels within 100 kilometres. The only way to stop them, by anyone who wanted to send a message, was to "drop a book on the key". This meant literally that a book or some heavy object was placed on the transmitting key, setting up a continuous roar of interference through which nothing could be heard.

These and many other types of interferences, with everyone operating at will on the same frequency, led to feuds and quarrels, filling the air with curses, aspersions and choice obscenities. With Marconi trying to establish a monopoly, his operators answering only colleagues of the same company, and with foul language the order of the day, the service was far below the efficiency it could have reached and the need for international regulations arose. The first preliminary discussion was called for and held in Berlin in 1903.

Nine countries attended this discussion. It was laid down that "Coast stations should be bound to receive and transmit telegrams originating from or destined for ships without distinction as to the system of radio used by ships".

The first Radio Conference was held in Berlin in 1906. It was agreed to give absolute priority to distress messages; to avoid radio interference as much as possible; that 1000kHz and 500kHz frequencies be set aside for the maritime services; that frequencies below 188kHz be reserved for long distance communication by coast stations, and between 188kHz and 500kHz for military and naval use.

Ship-to-shore radio communication procedure was laid down. Stations were required to have a government licence, and operators had to be capable of receiving and transmitting at 20 words per minute. Finally, the new Morse code distress signal "...—..." (SOS) was adopted, although it did not come into general use until some years later.

The next conference was in London in 1912. At that time, in addition to a large increase in maritime stations, there were some aircraft and dirigibles fitted with radio, but delegates felt that it was too early to take any official action in this new sphere.

Three new services were in use in 1912; radio beacons, weather reports and time signals, and the frequencies for these were set down.

Fifteen years later (1927) the next conference was held in Washington. By this time it had become necessary to restrict severely some of the older types of transmitters and divide the radio spectrum in a careful manner to deal with ever increasing demands. Except for low power sets, spark transmitters were completely forbidden by 1st January, 1930.

The 1967 maritime conference in Geneva was the first conference devoted exclusively to problems of communication between ships, or between coast stations and ships, since the London conference of 1912. The 1967 conference made provision for the gradual introduction of SSB radiotelephony on HF and the use of VHF between 156MHz and 174MHz. Also, the use of selective calling systems by coast stations to ships, and general measures to increase safety at sea.

Technical questions on the agenda for the 1974 conference were many and complex. There were 2200 proposed amendments or additions to the regulations.

LOCAL AND OVERSEAS NEWS

POSTAL DELAYS

Mail to hand during May, 1974, reveals that several events missed being publicised due to delays in the mail.

Some regular local and overseas despatches, usually received within a few days of posting, arrived up to seven weeks after date of postmark.

If your special event has not been mentioned, it would have taken place before it could be published.

A point to note:— To ensure inclusion in these columns, details must be received at least six weeks prior to the beginning of the month in which such happenings are scheduled to take place. See also footnote on this page.

MOONBOUNCE ACTIVITIES

Work continues on the Illawarra Branch moonbounce RTTY equipment. A receiving system constant-current teleprinter magnet driver is working and is an improvement over the polar relays. A new transmitter oscillator interface was made up to go with the new receiving unit. Both have been used by Lyle, VK2ALU on 7MHz contacts with VK3KF and VK5IF to prove that the system is operational.

The new transmitter frequency source unit was tried with temporary crystals and works satisfactorily. The crystal oven was not used as it requires 2 amps at 20 volts and a larger 20 volt supply will have to be made. This equipment can be modified for frequency shift keying, but requires a type BA163 capacitance diode, which appears to be no longer available. If anyone has a spare, Lyle would appreciate it being made available.

QSL cards were received from G3LTF to confirm the 432MHz E-M-E contacts on 30th and 31st March, 1974. (See last month's notes.) The contact has already received worldwide publicity for VK2AMW.

E-M-E tests were carried out on 27th April, 1974, with K2UYH, W4NUS, W9WCD, W0YZS, W8YIO and W0EYE. A good RTTY contact was had with K2UYH but he did not have RTTY equipment available. However, he taped VK2AMW transmissions for later "printout". A signal was heard from W4NUS but it was not good enough to make a contact. The other stations were not heard.

The operators at VK2AMW during the tests were Lyle, and Charlie Proctor, VK2ZEN. Lyle comments that Charlie's CW is getting better and better. After all, not many get CW practice via moonbounce.

Test equipment has now been received, by courtesy

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

AMATEUR BANDS

of the Wollongong University College. Lyle says that it will be a big help in getting the best out of the equipment and will reduce dependence on the CSIRO who have assisted with some of the systems tests.

A SAFARI SOUTH

Early in May the author made a quick trip to Melbourne and had brief discussions with some of the well known amateurs. Max Hull, VK3ZS, is a past federal president and has been active on the WIA federal executive for many years. Max is still active gathering historical facts about amateur radio in Australia. He would welcome any information to fill the gaps that still exist. Business commitments prevent "on the air" activity.

Jay Lancaster, VK3JL, past federal secretary, was, until August, 1973, associated with the WIA Victorian division's AOCP classes. Work commitments still keep Jay off the air. However, he says that it may be less than two years until he will have time to become active on the bands once again.

Ken Pincott, VK3AFJ, is well known as past editor of "Amateur Radio". Ken has recently found time to come back on the high frequency bands, using an FT200. Ken has a story to tell about his efforts to dig the hole for the concrete base of a tower when one of the big "wets" occurred in Melbourne.

However, one thing that the three of them have in common is that they are all Honorary Life Members of the Wireless Institute of Australia. An honour each had earned by years of work devoted to amateur radio and the WIA.

On the return trip I had a short chat with Don Haberecht, VK2RS, in Albury. Don's business activities keep him busy, but he finds time to operate on HF, especially 1.8MHz, where he has had many successful and interesting DX contacts.

GOLD COAST AWARD

The Gold Coast Certificate Award is issued by the Gold Coast Radio Club in Queensland, to amateurs and short-wave listeners. Applicants must contact five member stations of the club, plus the official club station VK4WIG. The club station is on the air from about 9.00 pm EST on the second Friday of each month.

A list of member stations will be forwarded on receipt of a stamped self addressed envelope, by the Awards Manager, Gold Coast Radio Club, PO Box 588, Southport, Qld. 4215.

VK4EN — MACKAY Q'LAND

The April, 1974, notes gave details of VHF DX contacts by Ron Kerle VK4EN. Here are some particulars of the equipment and some details about Ron himself.

It is not yet two years since, at the age of 16, Ron gained his limited licence. After operating for just over 12 months as VK4ZAT, he passed the Morse code test and became VK4EN. His main interest is in the VHF bands and, in addition to the reported two metre contacts, has made several hundred six metre contacts.

Included in the six metre contacts were all VK call areas (except VK0), ZL1 to ZL4 and many JA stations. When time permits Ron aims to do some work on 432MHz and amateur TV. He hopes to have some two metre SSB equipment in operation soon to use with the OSCAR satellite.

The current two metre equipment is a converted AWA MR6A, with an output of 4 watts into a pair of vertical five element Yagi antennas, 14 metres high.

On six metres, he uses a converted Pye Mk.1 on 53.1 and 53.032MHz, and a converted AWA MR6A on 52.525 and 52.656MHz FM. For SSB he uses a home built six metre transverter with an FL200B HF transmitter. The six metre antennas are a five element horizontal beam and a quarter wave ground-plane. The receiver is a Trio, but there are plans for construction of a solid state receiver combining the HF bands as well as six and two metres.

On HF the antennas are a 20 metre dipole and 40 metre quarter wave vertical. Finally, to use Ron's own words, "Time and weather permitting there will soon be a ten metre beam going up."

ITU NEWS

Region II

The editorial "Zero Bias" in "CQ" for April, 1974, comments at length on a million dollar TVI law suit brought against a USA amateur in New Jersey. It points out that regardless of how groundless a law suit may be it must be defended and that costs money.

While the comments acknowledge that the ARRL does provide advice and information that could assist in the defence of a client, the suggestion is made that the ARRL examine the possibility of providing some form of insurance cover for members confronted with a law suit related to amateur activities.

Region III

Australia: Executive members of the WIA elected at the 38th federal convention held over Easter, 1974, were: Dr D. A. Wardlaw, VK3ADW; Surg-Capt S. J. Lloyd, VK3CDR; Messrs J. J. Martin, VK3TY; D. H. V. Rankin, VK3QV; K. V. Roget, VK3YQ and P. A. Wolfenden, VK3ZPA. The Secretary, P. B. Dodd, VK3-CIF, continues in that office.

Papua New Guinea: It has been reported that the ITU has allocated the call sign series: P2A-P2Z to that area. Republic of Singapore has been allocated S6A-S6S.

RADIO CLUB NEWS

Geelong Amateur Radio & TV Club

The committee elected at the annual general meeting on 26th April, 1974, included four who had not served in that capacity before. Members for 1974-1975 are: President: Alan Bradley, VK3LW; Vice-president: Bob Wookey, VK3IC; Secretary: David Mann; Treasurer: Harold Selman, VK3CM; PRO: Carlo Gnaccarini; Tech. Officer: Dick Morrison, VK3YGE; Property Officer: Michael Batt; Newsletter Editor: Mike Trickett, VK3ASQ.

Two changes were made to the GARTVC constitution.

a. Persons in receipt of aged or invalid pension be entitled to 50pc fee reduction.

b. That application for new membership must be accompanied by a nomination fee equal to 50pc of the membership fee applicable.

Membership rates from 1st May, 1974, are: Full members $10.00 per year; Junior members $5.00 per year.

Several changes are being made in the club's activities on Friday evenings. These should provide better facilities for study classes, use of workshop and library and "ragchew" environment. The organised monthly activity will normally fall on the third Friday in the month.

The GARTVC was founded in 1948. The club call sign is VK3ATL / T. The club rooms are in Storrer Street, East Geelong. Postal address: PO Box 520, Geelong 3220.

RADIO CLUB DIRECTORY

An invitation is extended to all radio clubs to again supply up-to-date information relating to their club. Information received between now and the 16th October, 1974, will be included in the Radio Club Directory to appear in these notes for December 1974. Details required:—

Name:.................... Club Call Sign:...........

Meeting Place:........... Day & Time:..............

Affiliation:............... Net frequency:..........

Contact:................. Telephone:................

Central Coast Amateur Radio Club

A modification has been made to the slow call sign "tune up" facility incorporated in the channel 1 repeater, VK2RAG. While the slow call sign is being sent the level of the MCW tone is reduced by 20dB.

This was necessary because the normal tone level caused movement of the limiter meter on narrow band receivers, making receiver alignment difficult.

Operators wishing to use the slow call sign "tune up" facility should transmit an audio tone of 180Hz + or — 4Hz for at least one second. On cessation of the input carrier, the repeater will hold up and transmit "VK2RAG" at low level at three words per minute. The slow call sign may be finished quickly by transmitting a short carrier burst into the repeater.

The latest membership list shows the call signs of 36 licensed amateurs in and around the Gosford area. Club meetings are on the first and third Friday nights of each month, in the club rooms, Dandaloo Street, Kariong. The location, just off the Pacific Highway at the Woy Woy turnoff.

Annual subscription fees are:

Members — $5.00

Members' wives — $1.00

Students and pensioners — $2.50.

Illawarra Branch

To assess what could stimulate interest in current activities and to plan future projects, the Illawarra Branch committee has circulated a questionnaire to members. No identification is required so it is hoped that full and honest views will be expressed. The result will be discussed at the July meeting.

Points raised cover: Attendance at, and topics discussed at, meetings; moonbounce and repeater projects; social events and club affiliations.

The aim of the committee is to cater for the technical and social interests of amateurs in Wollongong and the surrounding areas.

Meetings are held on the second Monday of each month, at 7.30 pm in the Committee Room, Wollongong Town Hall. Visitors welcome.

Westlakes Radio Club

An interesting community help project involving members was planned to commence in mid-May.

The scheme involves some Legacy widows who are in poor health. The Legacy movement has planned an alarm system to be fitted in their homes, which will consist of a flashing lamp with a lantern battery as the source of power.

Should the lady be taken suddenly ill, she can summon the assistance of a neighbour who has been warned to watch for the light.

The equipment is being made available by Legacy but, if the installation was done commercially, the cost would probably be more than that of the equipment. This is where club members will assist.

The Elementary, Junior and Intermediate YRCS certificate classes conducted each Saturday afternoon are progressing well. The classes are conducted by former YRCS students Jamie Campbell, VK2YCJ, and David Crofts, VKYBR.

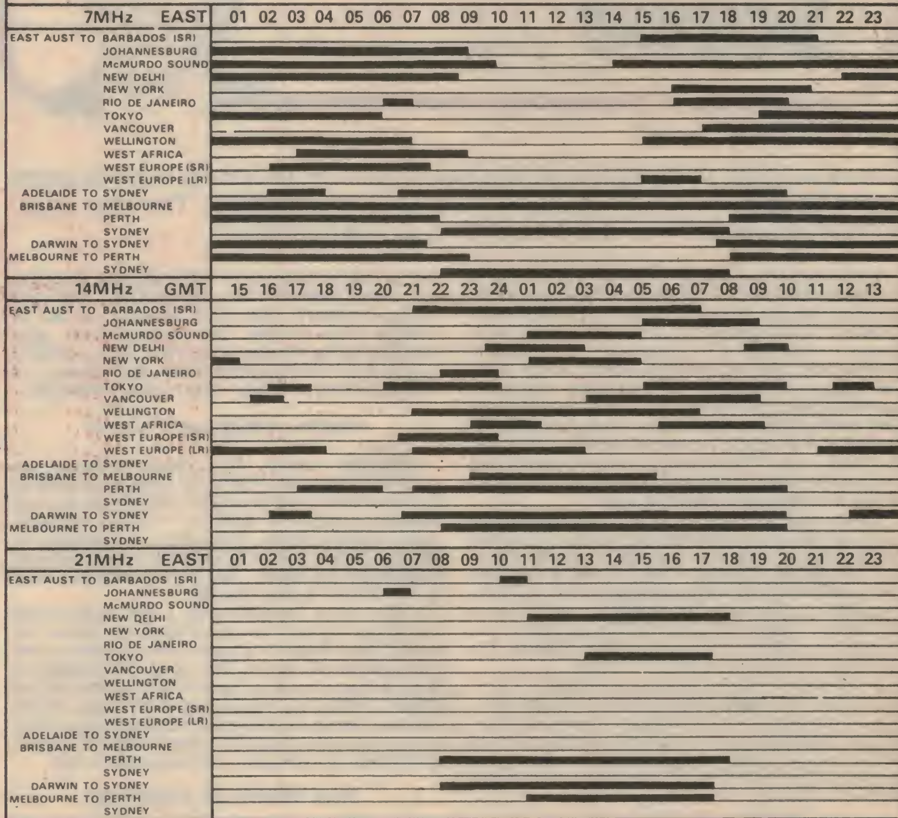
At the beginning of May, 1974, membership stood at 106, 54 with call signs.

Good progress is being made on the new club rooms in York Street, Teralba. Extensions to the main building are taking shape and transfer of all activities to the new centre may not be very far off.

For details of the club write to Secretary, Eric Brockbank, VK2ZOP, PO Box 1, Teralba, NSW 2284.

IONOSPHERIC PREDICTIONS FOR JULY

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 7.74



Maitland Radio Club

Preparations are being made for the state supervisors' conference of the WIA Youth Radio Club Scheme on 31st August and 1st September, 1974.

The MRC co-operation with other organisations in the area is a basic club activity. Recently the club's display unit was installed and manned by club members at the School of Arts, Largs, as part of the School of Arts committee drive to raise funds.

On Anzac Day the club again made its public address system available to the East Maitland Sub Branch of the RSL for the 11.00 am service. Sub Branch president, Mr A. O'Hearn, thanked the club and members who installed and operated the equipment.

MRC member, Walter Pomeroy, has gained his AOLCP. Having previously gained the YRCS Elementary and Junior certificates, Walter joined the AOCP class. He is also QSL officer for the club.

Eastern Zone VK3

In spite of inclement weather, an excellent convention was held at Moondarra by the Eastern Zone WIA Victorian division on 27th-28th April. At a special meeting prior to the convention dinner on Saturday, 27th April, several important matters were discussed. George Francis, VK3ASV, reported on the resiting of the Eastern Zone repeater, VK3RAB. Tests have been completed, the experimental repeater unit dismantled, and the special permit will be relinquished at the end of May 1974.

Graham Colley, VK3QZ, repeater officer, gave details of the resiting at the ABLV4 transmitting station on Mt Tassie, south of Traralgon.

It was decided to change the Sunday evening 80 metre hookup time to 2030 EAST (3650KHz). Control operator will be David Scott, VK3DY. Call sign VK3BEZ.

Following an enjoyable dinner, Graham Colley screened his colour slides of Iceland and Greenland. Grigor Cox, VK3ZCG, gave an excellent talk on a simple but effective 2 metre co-axial, co-linear aerial that could be made cheaply and easily using co-axial cable and insulation tape. The aerial can be erected on any mast or tree, at home or in the field, or supported vertically in a fibreglass tube at the top of a mast. Grigor recently returned from a visit to the North Island of New Zealand. (Some comments on his trip and repeater operation in New Zealand in next month's notes.)

On display were three excellent examples of home built equipment. These were: a 2 metre transverter by Norm Langmaid, VK3ZQC; an amateur band SSB solid state receiver by Keith Heistech; and a working model set-up consisting of a beam splitter for a BWD CRO, a wein bridge audio oscillator, and an "Electronics Australia" style frequency counter, displayed by Bruce Hocking, VK3ADB. Joe Rogers, VK3TO, was guest judge of the equipment.

As is usual at these conventions, a highlight was the disposal auction sale each day. These were organised by Bob Sherlock, VK3ZUN. The auctioneer was the Eastern Zone president, Bruce Hocking.

Shortwave Scene

by Arthur Cushen, MBE

The new Radio Nacional Brazilia has been heard on 15245kHz with excellent signals during the English program from 2100 to 2200GMT. The new transmitter forms part of the rapidly expanding service from Brazil.

Following a series of tests, which included the use of 11820kHz at 2200GMT, Radio Nacional Brazilia is now broadcasting on a regular basis on 15245kHz from 1800-2400GMT. The programs consist of an hour of each of several languages with Portuguese at 1800GMT, German 1900, French 2000, English 2100, Italian 2200, and Spanish at 2300GMT. The station is asking for reception reports and promises to send a pennant and post-cards of Brazil, while those who send a cassette of reception will have a cassette returned featuring Brazilian music. The address is given at the opening and closing of each transmission, and the station uses a series of chimes as an interval signal.

International Broadcasting from Brazil is relatively new, but in the past few months the station has met with such success that they are rapidly expanding their services. Earlier this year transmitters of Swiss design were inaugurated for Radio Nacional Brazil, and these included a medium-wave transmitter of 300kW and a short-wave transmitter of 250kW. The address of the station is as follows: Radio Nacional de Brasilia, PO Box 07 / 0173 70000 Brasilia, D.F., Brazil.

In the second stage of the project, another 300kW medium-wave transmitter and four more 250kW short-wave transmitters will be installed. During the final stages, transmitters with an overall power of 1,000kW will be installed. These transmitters will be sited in the North and Northeast of Brazil and linked to the Central Station in Brasilia.

GALAPAGOS ON 4810kHz

Radio HC8VG, the Voice of Galapagos, has been heard testing on 4810kHz up to 0500GMT. According to a station announcement, heard by Chris Davis of Featherston, they are using a new transmitter of 5kW and programs are beamed to South America.

We first heard this station some years ago when it was operating on 6255kHz using 1kW, and subsequently confirmed reception. The station later moved to a lower frequency, and has now come back to this new channel of 4810kHz. Radio HC8VG is operated by the Mision Franciscana and broadcasts from San Christobal, Galapagos, which is an island group belonging to Ecuador and located in the Pacific Ocean. The local time is an hour behind Ecuador, so there is a good chance of this new signal also being heard by Australian readers.

NEW ZEALAND SCHEDULE

The latest schedule of the External Services Division of the New Zealand Broadcasting Corporation, formerly known as Radio New Zealand, is now as follows:

To the Pacific:	
1700-1945GMT	6080, 9755kHz
2000-0545	15110
0600-0845	6080, 9540
To Australia:	
2000-2300GMT	11780kHz
2300-0545	17770
0900-1145	9520,11705

HCJB CHANGES FREQUENCY

Broadcasts to the South Pacific from HCJB in Quito, Ecuador, have undergone a frequency change due to the fact that during our winter it would be difficult to receive transmissions after 0900GMT. The station is now using 6085kHz from 0500-0900GMT, and this replaces 11915kHz. The other frequency in use is 9745kHz which carries the program from 0500-1045GMT. In the morning service to Europe, 11740kHz is used from 0200-0530GMT, while the frequency of 5960kHz is used to Europe only from 0400-0500GMT.

LATIN AMERICAN NEWS

Interesting signals from South America are currently being heard during the winter afternoons in both the 49 and 60 metre bands. Radio Progreso, Loja Ecuador is heard on 5057kHz at around 0400GMT. Radio Chinchaycocha, Junin Peru is operating on 4860kHz with reception at 0400GMT. Chris Davis of Featherston NZ reports these signals amongst many being received around 0400GMT.

In the Central American area, a new station in the Dominican Republic has been noted on 4850kHz by several New Zealand listeners, and reported in the New Zealand DX Times. Tony King of Wellington is hearing the new station Radio Clarin at 0615GMT on 4850kHz, whilst our own reception has been around 0800GMT during the station's all night operation. They announce a medium-wave frequency of 860kHz and it is understood that the power on short-wave is 1kW.

VOA OCEANIA SERVICE

The Voice of America has added additional transmitters to its service to the South Pacific, which is broadcast twice daily. The transmission times for the whole Far East Service are 2200-0200 and 1100-1400GMT. The present service to Oceania is as follows:

GMT	kHz	Transmitter
1100-1200	5955	Dixon
	9730	Dixon
	11730	Philippines
	15345	Philippines
2200-2300	9545	Philippines
	15250	Delano
	15290	Philippines
	17820	Dixon

SWEDEN CHANGES FREQUENCY

During our winter period, Radio Sweden has made some frequency changes, as well as continuing to broadcast the program to Australia and New Zealand from 0230-0300GMT. The major changes are:

GMT	kHz	Area
0000-0130	11805	North America
0130-0330	11955	North America
0230-0300	11940	Australia, New Zealand
0400-0715	17770	Africa
1230-1330	17840	East Asia
1400-1530	17770	South Asia
1600-1730	15240	Middle East
1830-1930	11790	Middle East
2015-2115	11970	East Asia

INDONESIAN VERIFICATIONS

According to Craig Tyson, reporting in ADXN Radio, Cendrawasih has moved to 1525kHz, and many Indonesian stations are moving to medium-wave lengths. The possibility of receiving low powered Indonesian stations is remote.

We have received a verification, after 15 months, from Radio Pemerintah Daerah Kabupaten Simalungun on 4650kHz. The station advises that they have changed frequency from 4089 to 3510kHz for their other outlet. The frequency of 4650kHz is used at 2315-0200, 0430-0745, and 0925-1600GMT whilst a frequency of 3510kHz is used at 0215-0415, and 0800-0925GMT.

COOK ISLAND RADIO

An interesting letter has been published in the New Zealand DX Times concerning Radio Cook Island. The station states that they are having verification cards printed, and once reports are cleared by the Broadcasting Officer they will be passed on for QSL action. The Call of the Cook Islands, as the station is generally called, is at present transmitting on ZK1ZC on 600kHz with a 10kW transmitter located at Matavera. They broadcast from 6am to 4 pm Cooks Time, then from 6 to 10pm. On Sunday they operate continuously from 6 am to 10 pm, and recently also started full time transmission on Friday to cover sporting fixtures held in New Zealand on the Saturday.

Cook Island time is 10½ hours behind GMT. The shortwave service, destined for the outer islands, operates on 11760kHz on weekdays from 2030-2230GMT and 2330-0130GMT. Reports should be addressed to: The Manager, Cook Islands Broadcasting and Newspaper Corporation, PO Box 126, Rarotonga, Cook Islands.

LISTENING BRIEFS
EUROPE

DENMARK: Radio Denmark at Copenhagen has retimed its service to South America, and this is now broadcast from 2200-2245GMT. The transmission to the Far East from 0730-0815GMT is on the air daily except Mondays, while the service to Greenland at 0945 and 1130GMT is not broadcast on Sundays. Programs to North America at 0000GMT is now on 9520kHz, while all other transmissions are on 15165kHz. The programs are in Danish, and are of 45 minutes duration, except on Sundays where they last for 75 minutes. The station welcomes reception reports which should be addressed to: Denmarks Radio, Kortbolgeafdelningen, DK-1999 Copenhagen, Denmark.

SPAIN: Radio Nacional de Espana at Madrid has been heard opening at 2200GMT on the new frequency of 11860kHz with a service to South America. This transmission in Spanish is broadcast from 2200-0400GMT and the power used on this frequency is 700kW. Other frequencies used to carry the program are 9520, 11775, and 9630kHz.

SWITZERLAND: Reception of Berne during our afternoons is good at present, and this includes the service to North America from 0145-0415GMT on 6120, 9535, 11715 and 15305kHz. A further service from 0430-0630GMT is on 9725 and 11715kHz. The broadcast to Australia and New Zealand from 0700-0930GMT is now carried on 9590, 11775, 15305 and 17840kHz.

AFRICA

ALGERIA: According to DX Corner, Belgium Radio Algiers transmits in French to Europe and Africa from 0600 to 0900GMT and from 1800 to 2400GMT on 7245kHz and from 0900-1800GMT on 11835kHz. Programs to Africa are on the air from 0600-2400 on 15420, from 0600-0900 on 11910, from 0900-1800 on 17825 and from 1800-2400GMT on 11910kHz.

ASIA

KUWAIT: The Kuwait Broadcasting Service, which has the mailing address of Box 397, Kuwait, has advised a change of time for their English programs. The first transmission from 0500-0800GMT is broadcast on 15345kHz, while the second transmission from 1700-1930GMT is heard on medium-wave 1133kHz as well as 9715 and 15415kHz.

TURKEY: According to a report from Sweden Calling DXers, the Turkish Police Broadcasting Station in Ankara now has a verification card. The station operates on 6340kHz using 250W, and the most recent schedule is: 0600-1100, 1200-1600 and 1700-1900GMT. Reports should contain return postage, and some postage stamps are always welcomed by members of the staff. Reports should be sent to: Turkiye Pois Radyosu, T.C., Emniyet Genel Mudurlugu, Ankara, Turkey.

AMERICAS

PARAGUAY: According to an official announcement, a licence has been granted for the installation of a new SW radio station in Asuncion. The power of the station will be greater than 100kW, and transmissions will be beamed towards Europe. Programs will be in English, German, French and Dutch. There has been a time zone change in Paraguay, and local time is now 4 hours behind GMT.

COSTA RICA: According to a letter received from TIFC, they have been granted a new channel of 5020kHz, to cover the whole country, by the Costa Rican Government. They now await financial help for new equipment. The station is a Gospel broadcaster and already operates on 9645 and 6175kHz in a service to the Central American area.

Further details on other stations, and information on what is being heard by readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT, add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

MODEL RH-20 $20.00 Packing & Postage $1.00.

20,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.
Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current, 50uA, 25mA, 250mA.
Resistance: 7K, 700K, 7M.
Decibels: —10, +22 (at AC / 10V) +20, +36 (at AC / 50V). Upper frequency limit 7KHZ.
Batteries: Two 1.5V dry cells.
Complete with test leads

MODEL RH-80 $22.00 Packing & Postage $1.00

20,000 Ohms per volt DC.
10,000 Ohms per volt AC.
Specifications:
DC Volts: 0.5, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 5K, 50K, 500K, 5M.
Decibels: —10dB + 62dB.
Accuracy: DC 3pc.
AC 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

4-SPEED RECORD UNIT

"Ambassador" 4 speed 16, 33, 45 & 78 rpm stereo phono unit, complete with Ronette pickup. Stereo ceramic cartridge and stylus for LP and 78 records.
Packed ready to mount with screws and template for installation.

Instructions for connecting to amplifier or radiogram. 240V AC mains operated.

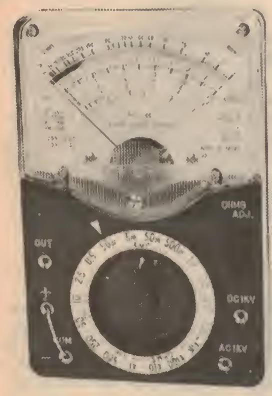
Posted NSW $16.50. Posted Interstate $17.00.

Reduced from $25.00. Special Offer.

Order now, limited stocks.

NEW RH (Radio House) RANGE OF MULTIMETERS

MODEL RH-60 $29.00 Packing & Postage $1.00



50,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.
Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 25uA, 5mA, 50mA, 500mA
Resistance: 10K, 100K, 1M, 10M.
Decibels: —10 +62dB.
Accuracy: DC ±3 p.c., AC ±4 p.c. (of full scale).
Batteries: Two 1.5V dry cells. Overload protected.

"HANDYMAN" RH150 $14.75

CHECKED PACKED & POSTED $15.50
Pocket-size 3¼" x 4½" x 1¼". Instruction sheet and circuit.
SPECIFICATIONS:
DC Volts: 2.5, 10, 50, 250, 1000. 10,000 ohms per volt
AC Volts: 10, 50, 250, 500, 1000.
DC Current: .1, 25, 250mA.
Resistance: 20K and 2M.
Decibels: —20dB, +62dB, 0.7KHz.
Capacitance: .0001, 01, .0025, 25uF

TAPE RECORDER

Book type Solid State tape recorder, operated by 2 torch batteries. Mike Records, plays back, erases automatically. Size 10½" x 6¾" x 1¼". Complete with mike and tape $19.75. Post and packing 75c.

When closed looks like a book

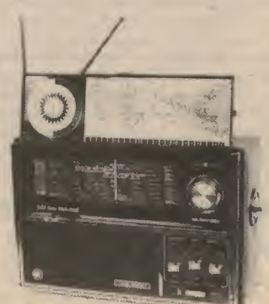
SPARE REELS OF TAPE
3" REELS
225 feet **50c.**

3" REELS
450 feet **80c.**

WORLD RANGE SOLID STATE DELUXE RADIO / MODEL /ACE TRS / 35 /

19 TRANSISTORS — 9 Diodes — 500 MW output.
SIZE 11" x 13" x 5".

FEATURES:—
1. Tuning knob
2. Fine tuning knob
3. On-Off push Switch
4. Volume Control
5. Tone Control
6. Squelch Control
7. Band selector knob
8. Time zone
9. Telescopic antenna
10. Dial light
11. AC / DC selector
12. Extension Antenna Jack
13. Earphone Jack



This new Solid State Radio is all-band, all transistor portable designed for super sensitive reception of Amplitude Modulation (AM) Marine Band (MB) International Short Wave (SW1, SW2) Frequency Modulation (FM) Public Service Band LOW (PB), AIRCRAFT (VHF1) High Public Service Band (VHF2) and Weather Band (WB).
These Bands will provide you with many hours of entertainment and excitement. This radio is also equipped for house electricity (240 AC) as well as by batteries (4 "D" cells).
PRICE:— **$135.00** pack & post $1.50.

RADIO HOUSE PTY. LTD.

306-308 PITT STREET 61-3832 26-2817 760 GEORGE STREET SYDNEY. 211-0171

BASIC "SHORT FORM" KITS FROM KIT PARTS LTD

ELECTRONIC DOORBELL. A two transistor circuit complete with necessary components and small speaker. Has provision for 2 door bell push switches (front and back door). The push switches aren't provided but can be obtained from any electrical store. It provides two different tones, one for the front door and one for the back. **Cost $5.40.**

LIGHT SENSITIVE MUSIC GENERATOR. A small unit which emits a musical tone, the pitch of which is determined by moving your hand over a light sensitive device. Contains 2 transistors, speaker and components. Simple to build. **Cost $5.20.**

MORSE PRACTICE OSCILLATOR (speaker version). A 2 transistor device with a small speaker that permits you to practise morse code. Runs off a 6 or 9 volt battery. All parts except morse key provided. **Cost $4.90.**

COMPRESSOR / PEAK LIMITER. A simple design which really works well. Runs off 6v DC or off your 6.3v AC heater chain. This kit includes a built in rectifier for operation off the heater chain. Ideal for your Ham rig, PA system, tape recorder, guitar amp (specially suited to bass guitar to give that rich 'chunky' sound). Incorporates fairly fast action and slow decay. Can be adjusted for peak limiting or compression. Can be fitted simply to any audio amp. Kit contains all the components plus circuit and explanation of function. **Cost $6.40.**

CODE PRACTICE OSCILLATOR (earphone version). Simple compact little unit drives a magnetic earphone. Very pleasant tone. Kit contains earphone, transistor, all parts except morse key, and circuit. **Cost $3.90.**

METAL LOCATOR. Detects metal to a depth of 18". Can be fed into a pair of headphones, either low or high impedance, or to a small amplifier. Full pictorial details for building the search coil. Also diagram for recommended layout. Gives rather outstanding performance for such a simple device. Entirely portable with all up weight of only 2 lb. Great for finding metal objects under the sand at beaches. **Cost $7.95.**

COLPITTS XTAL OSCILLATOR. For testing xtals. Handy to have around. Kit contains xtal socket, xstr, components and diagram. **Cost $2.70.**

TRANSMITTER FOR RECORD PLAYER OR GUITAR. Transmits at top of broadcast band, with adjustable tuning. Plug in a guitar or record player and transmit to your nearest radio. Only a foot or so of aerial wire is required to cover 20ft. Kit contains 2 xstrs, prewound coil, variable capacitor, all necessary components and diagram. NB. It is illegal to connect a microphone to this unit for the purpose of xmitting voice. Really simple to build. **Cost $4.90.**

ELECTRONIC SIREN. Exceptionally realistic — can be hooked onto a large amplifier if required. Contains its own small speaker. Ideal for junior to mount on his bike. Contains 2 transistors, speaker, push switch, components and circuit. **Cost $4.90.**

VHF RECEIVER. One of our best sellers. Suitable for covering from 27-130 mcs with different coils. Uses one transistor and operates on the super regenerative principle. Little external radiation. Can be used in conjunction with a standard transistor broadcast receiver by merely standing the VHF receiver against the transistor radio, and tuning the transistor radio to a clear point on the dial. Also fitted with an audio output for connection to a high impedance earphone or external amplifier. All pieces including metal front provided. Step by step pictorial assembly instructions included. Easy to build. Listen to police, taxis, aircraft, fire brigade, etc. Fascinating night time entertainment. No external aerial needed — only 3 ft of stiff wire. **Cost $5.40.**

PROXIMITY ALARM. A simple passive proximity alarm. Anyone approaching within one to three feet of it (depending upon how it's set) will operate the built in relay. Ideal as a simple burglar alarm, to detect milk box thefts, peeping toms, etc. Excellent proximity alarm for jewellers, etc. Ideal as a capacity switch to activate displays. Completely self contained — only 4 transistors — battery operated. This device operates on a static charge principle and is very popular overseas. Kit includes components, instructions and circuit. No metalwork or layout. This is left to your individual taste. **Cost $8.90.**

STROBE FLASHER. Produces incredible stroboscopic flashing light effects — used by dance bands for stage lighting effects. Our circuit uses ordinary light bulbs rather than expensive 'strobe' bulbs — easy to build and set up. Will drive 6 standard 100 watt light bulbs — adjustable flash from 'Sunburst' (one flash in 5 seconds) to 30 flashes per second. Incredible effects. **Cost $8.40.**

BAXANDELL TONE CONTROL. A 2 transistor tone control circuit — ideal for adding in front of our 5 watt amp (kit No. 49) or **any** amplifier circuit. Max input level 200mv. Input impedance 200k ohms. Output 50k ohms. Operates off 9-18 volts with a slight gain of up to 6db. Treble and bass response approx 16db cut and lift at 40cps and 20,000cps. Uses 2 low noise silicon transistors. Complete with bass and treble potentiometers and all components. **Cost $3.90.**

5 WATT AMP. A very popular kit — can be assembled in under 2 hours with only a basic knowledge of electronics. Step by step pictorial instructions. Only 4 xstrs, 10 resistors, and 5 condensers to solder in place. Operates off 9-18 volts. Runs off battery or power supply — power supply circuit provided. Input impedance 20k ohms. Input sensitivity 20mv. Output load 3-15 ohms. Everything, including tag-board, provided (not metal base). **Cost $6.00.**

5 WATT AMP WITH TONE CONTROL. This is a combination of our 5 watt amp (kit 49) and our baxandell tone control (kit 48) mounted together on a silk screened printed circuit board. Can be used in conjunction with a ceramic or xtal cartridge. Two of these units make a high quality stereo amplifier. Input impedance is 200,000 ohms which can be raised by adding a series resistor. Input sensitivity is better than 20mv. Can be run off a battery for low power. Kit includes PC board. **Cost $9.90.**

HEE HAW SIREN. A highly realistic European style siren which operates a loudspeaker (supplied with kit) when turned on. Runs off 9 volts. Ideal for children's trikes, pedal cars, etc. A real attention getter. Tag board and complete step by step pictorial instructions provided. About 3 hours of work required to construct this unit. **Cost $6.80.**

250 MW AMP. A simple 3 transistor amp which comes with a 3" high impedance speaker. Input impedance is 30,000 ohms and sensitivity is 20mv. Tag board provided, along with pictorial layout and constructional details. Assembly time is about 2 hours. A handy little general purpose amp — runs off 9 volts — can be used with either negative or positive earth. Handy for amplifying the output of a xtal set or other small signal output devices. **Cost $6.50.**

HOMODYNE TUNER. From Electronics Australia Nov. 1973. This is the discrete component version of this kit which has proven to be one of our most popular sellers. This kit is complete to the last nut and bolt and includes an attractive anodised cabinet and silk screened front. The heart of the unit is a pre-aligned permeability tuner and a handful of components with PC board. Only a voltmeter is required to align the tuner. Performance is crisp and clear. Operates off 12 volts. Feeds any amp with its 500mv output. Cabinet and metalwork prepunched. Full instructions supplied. Average assembly time 4-6 hours. **Cost $24.00.**

ITEMS REQUIRED..

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I enclose cheque / money order, including 50 cents extra to cover postage.
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WELLINGTON KIT PARTS LTD — ALL RADIO COMPONENTS **MONEY BACK IF NOT COMPLETELY SATISFIED**

P.O. BOX 27 037, Wellington, New Zealand.

DEAR KIT PARTS — PLEASE RUSH MY ORDER — THIS BATH IS GETTING COLD!

INFORMATION CENTRE

DWELL EXTENDED: I recently came across an article in the February 1970 issue entitled "A Dwell Extender". As a beginner in electronics I thought that this was a good place to start building projects. It was here also that I struck my first problem — my vehicle is a positive chassis Ford Zephyr. Could you tell me whether I can install the Dwell Extender in this vehicle? (C.T., Homebush West, NSW.)

No problem at all. Just connect the circuit the opposite way around so that the SCR anode goes to the vehicle chassis and the cathode goes to the positive coil connection.

TRANSISTOR SUBSTITUTION: I recently purchased a kit for the Playmaster 136 Stereo Amplifier from one of your regular advertisers and have discovered that I have been supplied with a PN4250 transistor for TR10 instead of a 2N4250. Could you please advise me if these are compatible both in regard to electrical characteristics and lead configuration? Congratulations on a first class magazine.

The PN4250 transistor with which you have been supplied is electrically identical to the 2N4250 transistor (TR10) originally specified for the Playmaster 136. Changeover to a more modern mass production technique has necessitated dropping the glob-top construction in favour of the "TO-92" configuration in which the pins are in line, and the PN4250 transistor is one of these.

In regard to the lead configuration, you would be well advised to check the manufacturer's data handbook. If it is a Fairchild transistor, then the emitter and collector leads for the PN4250 are transposed relative to those on the 2N4250. However, this remark is not necessarily valid for all PN4250 transistors and TO-92 package transistors from other manufacturers. Note that if you have been supplied with further TO-92 package transistors for the power modules, the above remarks on lead configuration also apply. These points were discussed on pages 51 and 52 of the January 1974 issue and on page 46 of the February 1974 issue, to which we would refer you.

Thank you for your kind comments regarding the magazine.

DEAD LETTER: We are holding a letter addressed to Mr A. R. Mason, GPO Box 129, Cloncurry, Queensland, 4824. This has been returned marked, "Left address. Whereabouts unknown". If Mr Mason will supply his new address, we will forward the material to him.

ELECTRONIC CRO SWITCH: In the December 1962 issue you published a circuit of an electronic switch for showing two signals simultaneously on a single trace oscilloscope. This is pretty old now but the circuit sounded good and I am wanting to build one but the 6AE8 valves are obsolete. Do you plan to update this circuit? Alternatively, can you suggest a replacement valve that would serve? (L.J., Christchurch, NZ).

As you can see from the article earlier in this issue, we do not just have plans to update the project, but have already done so! We hope you like the new design, which is fully solid state. To the best of our knowledge there is no exact substitute for the 6AE8 valve used in the earlier unit, but you can still buy this valve itself at many TV service shops.

THANK YOU: Thanks for the excellent series on amplifiers in Elementary Electronics. It was extremely useful, and I hope to build a high power amplifier on my own, using the information gained. However, one thing puzzles me. You say 0.6V appears across a P-N junction. I presume this to be constant for all values of current. Therefore the resistance of the junction can be worked out from Ohm's law. However, in Fundamentals of Solid State the emitter resistance is given by the formula Re— 26 Ie. How come? Is the second formula right? Does it change for germanium and silicon. Also, could you do a series of oscillators in Elementary Electronics? (C.A. Sunnybank, Qld).

The fallacy in your reasoning stems from the statement, ". . . the resistance of the junction can be worked out from Ohm's law." While this is true for any specific combination of voltage and current, the value so calculated becomes meaningless if either one of these parameters changes. In simple terms, this resistance is highly non-linear, so Ohm's law does not apply. Incidentally, the figure of 0.6V is not absolute; it is an approximate figure which varies with changes in current. The answer to your questions are: The formula in Fundamentals of Solid State is correct, and applies to both germanium and silicon.

Thank you for your kind remarks about the magazine and we will keep your suggestion regarding an article on oscillators in mind.

DEAD LETTER: We are holding a letter for Mr P. V. Farrelly, addressed to 215 Main St, Kangaroo Point, Queensland, 4169. This has been returned by the PMG's Department marked "Not at this address". If Mr Farrelly will advise us of his new address, we will forward the letter to him.

MYSTIFIED: Being a person on a small budget, I am mystified why you build complex hi-fi projects that I, and many others, cannot build. Yet a low cost project like the Mini-Fi is not suitable. Some young people, like myself, have mono tape recorders with a few hundred milliwatts output. How about a mono amplifier with about 3-4 watts output? Also, why not design more receivers and transmitters from surplus goods? I know I am asking a lot, and I understand the problems associated with making a magazine such as yours. (C.F. Lapstone, NSW).

There is no mystery, C.F. We describe hi-fi systems because people want them. We know this because many, many thousands of them have been constructed. One particular amplifier, the Playmaster 136, has been constructed by well over 7000 people — and that's only the ones we have heard about.

In any case, we don't see what you are complaining about — a project which is exactly what you seem to want has already been done. The "Powered Loudspeaker for Portable Recorders" (Sept 1969, File No 1 MA 48) is the project to which we refer.

We are wary of constructing items using specific surplus items in projects because they may not be readily available to all readers. Just because Joe Blow's Surplus in Sydney has certain items in stock, there is no guarantee that the same items will be available in Perth or Brisbane. As a national magazine we must try to ensure that our projects use parts which should be available to all readers.

SSB TRANSMITTER: As an amateur radio enthusiast, I am interested in the SSB transmitter described in "Electronics Australia" from December 1966 to March 1967 inclusive, and have the following queries:
(a) Are all components still available?
(b) Does it use phasing or filter techniques?
(c) What valves are used in the driver and final stages?
(d) Has there been any notes and errata and or updating articles?
(e) Are the four relevant back issues still available? (D.B., St Georges, SA)

Considering your queries in order D.B., we suggest that you check with our advertisers regarding the availability of parts; filter techniques are used; a 6EH7 valve is used as a driver, whilst a 6DQ6B is used as the power amplifier; there were no notes and errata or updating articles published; the relevant back issues are no longer available. However, we can supply project reprints of the articles you require (File Nos 2 TR 41,42 & 43).

AMPLIFIER: I would like to make an amplifier, about 60 watts. I already have a 14-watt amplifier, and was wondering if I could remove the present speaker and put in a bigger one. The present speaker is about 8in diameter. How big a speaker would I need for 60 watts? If I was to remove the wires only of the speaker and put them on the bigger one, would I get any wow or fuzz, etc. (G.R. Bunbury, WA).

How long is a piece of string . . . Your questions are very hard to answer as they do not make much sense. The power output of an amplifier is not set by the size of the speaker, but by the amplifier itself. Installing a bigger speaker will not have much effect, unless you happen to get a much more efficient speaker. Provided the impedance of the speaker is the same, and its power handling capability is correct, you should not have any trouble. Note, however, that most speakers are designed to go into boxes specifically designed to suit the speaker. Operating the speaker in an incorrect box could damage it.

HOW TO USE OUR INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2). A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 80c per issue-reprint. Thus, a project spread over three issues will cost $2.40. Reprints are available for all projects, but no material can be supplied additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 40c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by separate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects, Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1. These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply transparencies, actual size, positive or negative, as specified. Price: 80c. We do NOT deal in manufactured boards. These are available from advertisers.

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 30c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 80c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications, etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia, and should be made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

POSTAGE & PACKING: All charges shown include postage and packing, unless otherwise specified.

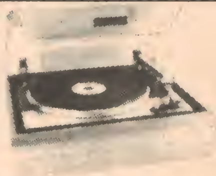
ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield 2014.

A.C.E. — AMPLIFICATION COMMUNICATION ELECTRONICS

PHONE 51-3845
51-7008

RADIO

136 VICTORIA RD., MARRICKVILLE NSW 2204



GARRARD

Model SP 25 Mark 4, The newly released latest model — a beautiful machine. 3 speed. 4 pole motor. Aluminium turntable. Fully balanced and CALIBRATED P.U. arm. Bias comp. cue & pause control. Click suppressor. Auto. set down.
Including Mag. Cartridge, Dia. Stylus $71.00
Pack & Post. N.S.W. $1.50. Interstate $2.50.
Mounting base with perspex cover $23.80.

Very latest model 3 speed record changer, deluxe model, 4 pole motor. Fully balanced tone arm. Big heavy weight turntable. Ceramic cartridge, diamond stylus $55.00
Mounting platform with hinged perspex cover $23.80

B.S.R. STEREO RECORD PLAYER

Model P-128. Latest design. 4-speed. Auto or manual operation. 11" heavyweight diecast turntable driven by fully shielded 4-Pole dynamically balanced 240V motor. Noise suppressor. Silicone damped cueing device. Square section brushed aluminium pick up arm. Adjustable counterbalance. Calibrated stylus pressure control. Antiskate bias compensator fitted with magnetic cartridge. Diamond stylus, also audio leads. $57.00
Pack & Post. N.S.W. $1.50. Interstate $2.50.

B.S.R. STEREO RECORD CHANGERS

Standard 3 speed model $36.75
Deluxe model with 12in turntable, Cueing device, ceramic cartridge, diamond stylus $46.50
Deluxe model as above with an adjustable counter balance, 2 spindles, calibrated stylus pressure control added $56.50
Deluxe model as above with 12in Diecast heavyweight turntable, 4 pole shielded motor, suitable for Magnetic cartridge $66.50
The latter two record changers can be supplied with magnetic cartridge and diamond stylus at $10 extra.

MAGNAVOX 8/30 SYSTEM TEAK OR WALNUT

1.6 cft complete	$58.00 ea.
8.30 Speaker	$16.50 ea.
3TC	$3.40 ea.
Fully built cabinet	$32.00 ea.
Cabinet kit	$22.00 ea.

COMMUNICATION RECEIVERS

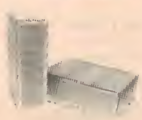
LATEST MODELS

Now available at greatly reduced prices. TR10 9R59DS. 550 KHz to 30 MHz. 4 bands. AM. SSB. CW. BFO. $148.50. Realistic. DX 150B. Solid state $182.00. Send SAE for full tech. Details.

SONATA NS-1600D

All silicon solid-state Hi-Fi Stereo Amplifier. 10 watts RMS per channel. Each channel has separate Bass Treble controls. Inputs for magnetic or ceramic cartridge, crystal mic, radio, tape — tape out, stereo headphones, 8-16 ohms. Instruction booklet circuit supplied. Timber cabinet. Dimensions 14½" x 8" x 4".
$67.50 plus freight $2.50.

NEW IMPORTED SPEAKER SYSTEM



Beautiful walnut cabinets 37 x 12 x 23 mm. The system is excellent quality and ideal to use as main speaker or extension with your stereo, cassette recorder, etc. $12.95 each or $23.00 per pair. P&P $1.00 each.

STEREO RECORD PLAYER

240V AC — 4 speeds, ceramic cartridge, separate motor, 7in turntable, pickup arm and rest. Post 50c $7.90

P.V.C. Hook-up wire 7/010 9 colours $4.75 per 100yds P. & P. 65c.

GRAMOPHONE MOTORS

3 speed, heavy duty, 240 V AC 50HZ $4.50. P. & P. 50c.

SOLDERING IRON

240V AC 30 watts, lightweight 2½oz, heating time 1.8 mins. $7.75

100 M/M VERNIER DIAL

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PHILIPS

Model AD 0160 T8 1" Dome Tweeter, $8.95 P&P 50c.

MAGNAVOX WIDE RANGE TWIN-CONE SPEAKERS

8-16 OHMS	30-16,000Hz
6WR MK5 12W RMS	$9.90
8WR MK5 16 W RMS	$10.75
10WR MK5 16 W RMS	$11.50
12WR MK5 16 W RMS	$13.50

Pack and Post 65c.

GUITAR AND ORGAN SPEAKERS

Pioneer 15" 20-7500 Hz Res 45 Hz 30 WATTS RMS $33.00
Rola 12" 12U50 20-11000 Hz Res 45 Hz 50 WATTS RMS $35.00
Rola 12" 12UX50 20-13500 Hz Res 45 Hz 50 WATTS RMS $40.00
Goodmans audiom 18 P 18" 100 watts—8 OHM $98.00
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Indicate imp. required with order, 8 or 15 ohms.

BURGLAR ALARM

Battery operated 2 x 1.5v Pen Light, simple to install on doors or windows — when activated, buzzer squarks at frightening pitch $2.95 P. & P. 35c.

AMERICAN ROBINS BRAND 5

Recording Tape 1800ft 1 mil. Mylar Low noise $3.50 P & P 35c. MT7" spools 65c P & P 25c.

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4000 UF 80V Chassis Mt	$3.25 each
2200 UF 63V C.M.T.	$1.25 each
	4 for $4.00
470 UF 63V C.M.T. 4 for	$3.00
80 UF 15V C.M.T. 12 for	$1.60
50 UF 12V C.M.T. 12 for	$1.50
50 UF 6V Pigtail 12 for	$1.30

MUSICOLOUR II

Operates in conjunction with your home Hi Fi or P.A. System, and as the music plays, different coloured lights respond. The Musicolour II has three channels. The max. number of coloured lights is not to exceed 1500 watts per channel. As per EA Dec '71, Jan '72. Complete kit of parts $49.50
Fully constructed $59.50
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50 WATT SOLID STATE GUITAR AMPLIFIER

50 watts RMS solid-state guitar amplifier. PM125 4 inputs, 2 channel with separate volume, bass and treble controls; speed and intensity controls for vibrato. Remote foot switch with plug and lead. Black vynex carry cabinet. Fully constructed and ready for operation off 240VAC $125.50.

FET-VOM

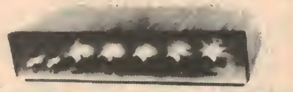
MODEL L-55

Input imp. 10M OHM. Supplied with standard probes, plus DCV Doubler probe.
Spec.
D.C.V. .3, 1.2, 6, 30, 120, 600.
AC.V. 3, 12, 60, 120, 600.
DC MA. .12MA 120MA
OHM .25 OHMS — 1000M
IN 4 RANGES
Dimensions 5" x 3½" x 1¾"
Carry case supplied, also book & Circuit.
$42.50, P & P $1.50

THE POCKET SIZE VOM MODEL.

With taut band meter and 30 ranges is now available. Specs. 20KOPV DC volts: 250 MV 5, 25, 50, 250, 500, 1KV. AC volts: 10, 50, 100, 250, 1KV. DC current: 50UA, 5, 50, 500MA. Resistance: RX1 RX100 RX 1K Centre Scale 30 3K 30K. V-U in DB: -20 to 62 dB in 5 ranges. Output: With internal .47UF 10, 50, 100, 250V AC. Capacitance 100PF to 0.6UF $34.95. P. & P. 80c.

PLAYMASTER 136 STEREO AMPLIFIER



As per Dec 72 E A
Full kit including Fairchild transistors $62.50
Metal work only $7.65
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Wired and tested $82.50

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Good frequency response, top quality reproduction two models available. The 45 Watts RMS has four 8" heavy duty speakers. Cabinet size 37" x 11½" x 10½", $49.50. The 25 Watts RMS has four 6" heavy duty speakers. Cabinet size 33" x 10" x 10" $37.50.
The columns are suitable for indoor or outdoor use — floor or wall mounting. Cabinets are covered with black vinyl. Imp 8 or 16 ohms.

MULLARD MAGNAVOX BOOKSHELF SYSTEM TEAK OR WALNUT

6WR MK5.3TC 8 or 16 ohms 15½ x 8½ x 8½ complete $31.50 ea.
Cabinet only $13.90 ea.

KAISE VOLT-OHM-MILLIAMMETER

MODEL SK-100

HIGH SENSITIVITY
100,000 Ohms per Volt DC
10,000 Ohms per Volt AC

SPECIFICATIONS:

- DC Volts 0.6, 3, 12, 60, 300, 600, 1200
- AC Volts 6, 30, 120, 300, 1200
- DC Current 12uA, 300uA, 6mA, 60mA, 600mA, 12A
- AC Current 12A
- Resistance 20K ohms, 200K ohms, 2M ohms, 20M ohms
- Decibels Minus 20 to plus 17, 31, 43, 51, 63
- Accuracy DC plus minus 3pc, AC plus minus 4pc (of full scale)
- Overload Protected by dual silicondiodes
- Double jewelled plus minus 2pc Meter
- Plus minus 1pc temperature stabilised film resistors
- Polarity changeover switch
- Scale with mirror

Price $34.75

Post 75c. Interstate $1.00.

stitute the reference subcarrier. Only when no colour is present will this facility be lost. This is not a serious problem, since any small drift will be corrected immediately colour re-appears or the reference burst is encountered, whichever occurs first.

Normally, the reference burst is used for a quite different function. While it is easy enough to lock the subcarrier reference oscillator to a signal running at twice its frequency, there is a possible 180 degree ambiguity with such a system. Thus, at switch on, or when a channel is selected, there is a 50-50 chance whether the subcarrier oscillator will lock on exactly in phase, or 180 degrees out of phase. In the latter event the colours will be inverted, as already described in connection with the electronic line switch.

(Local enthusiasts overcame this problem by providing a push button with which to stop and re-start the reference oscillator as many times as necessary until it locks in correct phase. While such a requirement may not be acceptable to the general public, these enthusiasts regard it as a very minor inconvenience in return for being able to resolve colour programs before transmissions officially start.)

The sole use made of the reference burst in a PAL-P receiver is to remove this possible ambiguity and, although it is available for this purpose at the end of every line, it is normally only needed in the event of a signal interruption of some kind.

So far, there appear to have been no commercial PAL-P sets produced overseas, the majority of manufacturers standardising on the PAL-D system. The PAL-S system has similarly found few followers.

Another system, called by-pass PAL, was developed by the Sony company to "by-pass" PAL patents. It converts PAL signals to an NTSC type signal and, in the process, loses some advantages of PAL. Recent patent agreements have rendered it redundant.

The stated reason for ignoring the PAL-P system is usually that the added complexity is not justified in view of the small error which needs correction. While it is true that the error is small, the argument about added circuit complexity (and cost) is not so convincing, if only because such a circuit no longer needs the relatively expensive reference crystal. With the increasing use of ICs, it may well be that the PAL-P system could eventually be cheaper to produce.

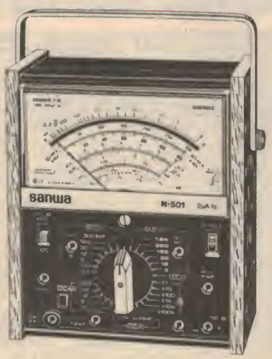
The name's the same, just the style's been changed.

From SANWA to sanwa

Why the change?

Because besides being more attractive, we think the new style presents a sharper image of precision. And precision is what Sanwa is all about.

For thirty years now we've been manufacturing precision measuring instruments. For customers throughout the world (in over a hundred countries, so far). For service engineers, researchers, radio hams — in fact for all kinds of people and companies involved in electronics.



Seventy per cent of all multitesters sold in Japan carry the Sanwa brand. Which isn't really surprising, since Sanwa multitesters have exceptional built-in capabilities. Versatility is a standard feature. So is sensitivity. And there are more than twenty-five models to choose from.

Sanwa: the name that's synonymous with precision.

WF WARBURTON FRANKI

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- MELBOURNE 69 0151 • NEWCASTLE 61 4077 • SYDNEY 648 1711
- WOLLONGONG 29 4137

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2400 Ft	Hub	$5.00
3600 Ft	Hub	$7.00
2400 Ft	Reel	$7.50
3600 Ft	Reel	$9.50

Write or Call NATSOUND P L, 261 Elizabeth St, Melbourne.

INTEGRATED CIRCUITS 7400, 7404 60c; 7474, 7491, 555 $1.50. Relays Miniature 12-24V 4 c o contacts with base. Burnlee Trading, P.O. Langwarrin 3910.

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BACK ISSUES. Electronics Australia. 1960-1969. $17. Phone 59-1497

FILMS, sound 8-16mm, Sell, Exchange. Raised pole film magnetic heads & circuit. Halpin, 12 Swinburne Ave. 3122. Hawthorn Vic. 81-4724.

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SONY 550 earth orbiter receiver. 8 band super sensitive 19 trans, BFO, RF gain, AFC. FM, LW, MW, 5SW, AC—DC. As new condition ideal for new or experienced swler. New $290 will sell $225 (negotiable). R. Barber, Gal. Coy, Duntroon, Canberra 2600, A.C.T.

50' STEEL TOWER 2 section triangular base. Good cond. $50 ONO. Ph A.H. 53 1357, 5 Prentice St, Elsternwick, Vic.

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All work guaranteed.

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DISPLAY ADVERTS IN MARKETPLACE are sold by the centimetre from a minimum of 3 cms. to a maximum of 12 cms. Rate $6.00 per column cm per insertion.

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CLOSING DATE is six weeks prior to the on-sale date. Issues are on-sale the first Monday of each month.

ADDRESS all classified orders, copy, enquiries, etc. to: The Advertising Manager, ELECTRONICS Australia, Box 162, Beaconsfield, 2014.

LANTHUR ELECTRONICS

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Including postage.

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One amp 400 PIV **5 for $1.00**
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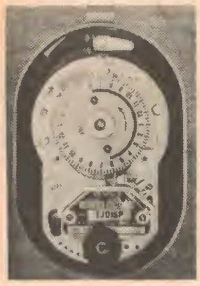

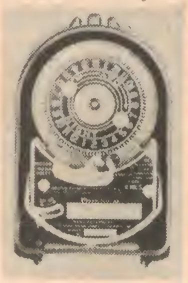

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NOTES AND ERRATA

PLAYMASTER 122 and 123 PROGRAM SOURCES (August and October, 1968, File No. 2/TU/27 and 2/TU/30): Some builders of these tuners have had trouble with AGC action, usually overcontrol with possible distortion and seriously reduced audio output. This may be cured by reducing the capacitor from the collector of TR6 to the base of TR7, from .001uF to a lower value until proper AGC action is obtained. It may be necessary to reduce the capacitor value to as low as 10pF in some cases.

PLAYMASTER 141 (Low Cost, Compact Home Stereo System) (June 1974, File No. 1/SA/49): Due to some last minute changes we were not able to reproduce the printed wiring pattern on page 59 of the June issue actual size, contrary to what is indicated in the blockline. The actual size of the printed wiring pattern is 172 x 140 mm.

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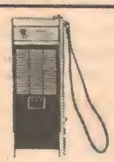

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Unit has audible alarm output. $12.95 PP 80c.

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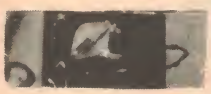
2 silicon transistors easy to build — all parts supplied including PC board and full instructions.



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(2 TELEPHONE SETS)

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Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only **$6.50** P&P 55c.

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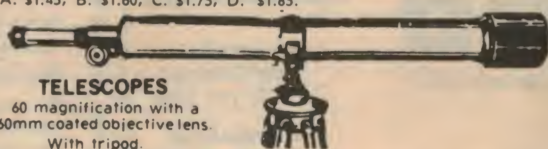

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With tripod.
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1-800 CYCLES
1-13 K/ CS. **$30.00**

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1½in diam. 1½FL 50c each.
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Dimensions, 9" x 5" x 5" $35 value only
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¼" x 2400' ON 10½" REELS
$3.95
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200 MA 24 volt, ⅛in push movement.
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A-250

A-350

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